ANNEX G

INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

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G.0 INVASIVE AND NUISANCE SPECIES MANAGEMENT PLAN

In accordance with the Comprehensive Everglades Restoration Plan (CERP) Guidance Memorandum 062.00 (CGM62), Invasive Species, the CEPP will incorporate invasive and nuisance species assessments and management of those species into pertinent planning documents and phases of the project. The Invasive and Nuisance Species Management Plan (INSMP) is a living document and will be updated throughout the Design, Construction and Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) phases.

The Project Partnership Agreement (PPA) and the Construction Phasing, Transfer, and Warranty (CPTW) Plan are developed and agreed to prior to construction. The documents outline the responsibilities of the federal and non-federal sponsor during the construction phase, the operational testing and monitoring period, and the OMRR&R phase, and will include the cost estimates associated with this INSMP. This INSMP must be included with the CPTW Plan.

This plan was developed with the input and guidance of multiple agencies and subject matter experts. The following provided text, technical guidance, and cost estimates.

- South Florida Water Management District – David Black, LeRoy Rodgers
- U.S. Army Corps of Engineers – Jeremy Crossland, Angie Huebner, Jon Morton, Jessica Spencer, Sue Wilcox
- U.S. Fish and Wildlife Service – John Galvez, Art Roybal
- Everglades National Park – Jeff Kline, Jonathan Taylor
- Florida Fish and Wildlife Conservation Commission – Jenny Ketterlin Eckles, Kelly Gestring
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G.1 INTRODUCTION

The Central Everglades Planning Project (CEPP) encompasses the Everglades Agricultural Area Storage Reservoir, Decompartmentalizaton of Water Conservation Area (WCA) 3, Everglades National Park (ENP) Seepage Management, and Everglades rain driven operations. The components of this plan are highly interdependent features that will be implemented in a comprehensive and integrated manner and are the main portion of CERP.

Nationally, more than 50,000 species of introduced plants, animals, and microbes cause more than $120 billion in economic damages and control costs each year (Pimentel et al., 2005). Not all introduced species become invasive species. According to the Office of Technology Assessment, Harmful Non-indigenous Species in the United States report, approximately 10 to 15% of introduced species will become established and 10% of the established species may become invasive.

Executive Order (E.O.) 13112, entitled *Invasive Species*, signed 03 February 1999, states an "invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Alien species means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not native to that ecosystem. Invasive species are broadly defined and can be a plant, animal, fungus, plant disease, livestock disease or other organism. The terms 'alien' and exotic also refer to non-native species. A native species is defined as a species that historically occurred or currently occurs in a particular ecosystem and is not the result of an introduction.

Invasive non-native species decrease biodiversity, displace native plant and animal communities, reduce wildlife habitat and forage opportunities, alter the rates of soil erosion and accretion, alter fire regimes, upset predator/prey relationships, alter hydrology, degrade environmental quality and spread diseases to native plants, animals and other organisms. Furthermore, invasive species are the second largest threat to biodiversity following only habitat destruction (Wilcove et al., 1998); invasive species are second in destructive nature only to human development. In the United States, invasive species directly contributed to the decline of 49% of the T&E species (Wilcove et al., 1998). In addition to environmental impacts, invasive species impact human health, reduce agricultural production and property values, degrade aesthetic quality, decrease recreational opportunities and threaten the integrity of human infrastructure such as waterways/navigation channels, locks, levees, dams and water control structures.

Florida is particularly vulnerable to the introduction, invasion and naturalization of non-native species. This is due to several factors including a subtropical climate, dense human population centers, major ports of entry and the pet, aquarium and ornamental plant industries. Major disturbance to the landscape has also increased Florida's vulnerability to invasive species. Alteration of the landscape for urban development, flood control and agricultural uses has exacerbated non-native plant and animal invasions. Florida is listed as one of the states with the largest number of invasive species. This list also includes Hawaii, California, and Louisiana. On average, 10 new organisms per year are introduced into Florida that are capable of establishing and becoming invasive and causing environmental harm. Approximately 90% of the plants and animals that enter the continental United States enter through the port of Miami (JP Cuda, 2009a). Stein, Kutner & Adams (2000) estimated that over 32,000 exotic species (25,000 plants and 7,000 animals) have been introduced into Florida. There are approximately 4,000-5,000 native species of plants and animals in Florida. The number of non-native species that have been introduced is eight times the total number of native species in the entire state.

The Atlas of Florida Vascular Plants (Wunderlin and Hansen, 2008) documented 4,289 plant species in Florida. Of the 4,289 plant species, 1,419 were considered non-native and were naturalized (freely reproducing) populations. The Florida Exotic Pest Plant Council (FLEPPC) identifies 76 of the 1,419 species of non-native plants as Category I species in the 2011 Invasive Plant List. Searches through existing data and resources indicate 156 non-native plant species have been documented to occur within the project area (refer to Table G-3: Invasive Plant Species Documented in the Project Area). Other non-native species are probably present; however, documented citations could not be located. Of the 156 species of plants documented to occur within the project area, there are 76 FLEPPC Category I species, 38 FLEPPC Category II species and 28 Florida Noxious Weed species.

Significant scientific evidence and research document invasive non-native plants are degrading and damaging south Florida natural ecosystems (Doren and Ferriter, 2001). Many species are causing significant ecological impacts by crowding out and displacing native plants, altering soil types and soil/water chemistry, altering ecosystem functions such as carbon sequestration, nutrient cycling and fire regimes and reducing gene pools and genetic diversity. Non-native invasive animal distribution, extent and impacts are not well understood, however implications of invasive animals are apparent in south Florida. It has been documented there are 14 non-native species that are causing direct impacts to threatened and endangered species and rare habitats. It has also been documented that 19 species within Florida are among the world's worst weeds (Holm et al., 1977).

It is estimated that federal, state and county agencies in Florida spend between $94 million and $127 million each year in an effort to manage invasive non-native plants (GAO, 2000).

Invasive species are a major threat to the success of CERP. "The intent of CERP is to restore, preserve and protect the south Florida ecosystem while providing for other water-related needs of the region. CERP focuses on hydrologic restoration to improve degraded natural habitat in the south Florida ecosystem. Hydrologic restoration alone cannot ensure habitat restoration (USACE and SFWMD, 2010)." In order to restore the Everglades and ensure south Florida's natural ecosystems are preserved and remain intact, invasive species must be comprehensively addressed (Doren and Ferriter, 2001). The lack of management will allow invasive non-native species to flourish and to continue to out-compete native species.

G.2 STATUS OF PRIORITY SPECIES AND THEIR IMPACTS

G.2.1 Plants

Table G-3 (Table G-3: Invasive Plant Species Documented in the Project Area) provides the list of non-native plant species that have been documented to occur within the project area. Searches through existing data and resources indicate 156 non-native plant species have been documented; other non-native species are probably present however documented citations could not be located. Of the 156 species of plants documented to occur within the project area, there are 76 FLEPPC Category I species, 38 FLEPPC Category II species, and 28 Florida Noxious Weed species.

There are four non-native invasive plant species and one native nuisance plant that infest large portions of the project area. These plant species are currently a concern and have the potential to impact project benefits. In addition there are four species of non-native invasive plants that have the potential to be spread by new project features and changes in operational procedures. These plant species are described below.

G.2.1.1 Widely Established Species

According to the 2013 South Florida Environmental Report, there are four species of non-native invasive plants infesting more than 144,770 acres within the Everglades Protection Area. These species include Australian pine (*Casuarina equisetifolia*), Old World climbing fern (*Lygodium microphyllum)*, melaleuca (*Melaleuca quinquenervia)* and Brazilian pepper (*Schinus terebinthifolius)*. The acreage of these plants was estimated by the SFWMD and the National Park Service (NPS) through regional invasive plant surveys utilizing digital aerial sketch mapping (DASM). The inventory was completed within the Everglades Protection Area, which is approximately 2.8 million acres in size, between March 2010 and February 2012. Wildlife management areas surveyed included Holeyland, Rotenberger, and Southern Glades. Other areas surveyed included Big Cypress Seminole Indian Reservation, Loxahatchee National Wildlife Refuge (LNWR), Everglades Wildlife Management Area (WCAs 2 and 3), the Miccosukee Reservation, Big Cypress National Preserve, ENP, East Coast Buffer Lands, South Dade Wetlands, and several other areas (SFER, 2013). Summaries on the distribution and impacts of these widely established species are included below. Other non-native plant species with limited or localized distributions or which have a high potential to spread into the project area are also discussed. These include torpedo grass (*Panicum repens*), tropical American water grass (*Luziola subintegra*), roundleaf toothcup (*Rotala rotundifolia*), and cogon grass (*Imperata cylindrica*).

G.2.1.2 Australian pine

Australian pine is an evergreen tree that can grow to 150 feet tall. It has inconspicuous flowers and produces tiny fruit, a 1-seeded winged nutlet that is formed in a woody cone-like cluster. Australian pine is a prolific seed producer and seeds are dispersed by birds, wind and water flow. It is native to Australia, the south Pacific Islands and southeast Asia. Australian pine was introduced in the late 1800's and was planted extensively in south Florida as windbreaks and shade trees. It inhabits sandy shores and pinelands and is salt tolerant. It also invades disturbed sites such as filled wetlands, roadsides, cleared undeveloped land, canal banks and levees. Australian pine grows rapidly shading out native species, produces dense litter accumulation, causes beach erosion and produces an allelopathic agent that inhibits growth of other species. In addition it interferes with nesting of sea turtles and the American crocodile (Langeland and Burks, 1998). According to the survey, approximately 6,986 acres of Australian pine are present within the survey area and it is the least abundant of the surveyed species. According to the SFER 2013 report, Australian pine is now at a maintenance control level in many areas within the Everglades. Maintenance control, as defined by the Florida Fish and Wildlife Conservation Commission (FWC), "is the coordinated and consistent management of invasive plants in order to maintain the plant population at low levels." The major infestations, approximately 87%, of Australian pine were present on SFWMD and Miami-Dade County lands in the South Dade Wetlands and Model Lands Basin. In these areas, Australian pine is present in remote mangrove swamps and sawgrass marshes where populations vary from dense stands to widely scattered patches. In ENP, this species is present in the northeastern sawgrass marshes in widely scattered patches.

G.2.1.3 Brazilian pepper

Brazilian pepper is an evergreen shrub or tree that can grow up to 40 feet tall. It forms dense thickets and is a prolific seed producer. It produces a small bright red fruit in the form of a spherical drupe. Brazilian pepper is native to Brazil, Argentina and Paraguay and was imported in the 1840's as an ornamental plant (Langeland and Burks, 1998) Brazilian pepper inhabits natural areas such as pinelands, hardwood hammocks and mangrove forests. It is an aggressive pioneer species that quickly colonizes and thrives in disturbed areas (Francis, n.d.) such as fallow farmland, fence lines, right-of-ways, roadsides, canal banks and levees. Seeds are spread primarily by birds and mammals through consumption and deposition of the fruit. Seeds are also spread by flowing water (Langeland and Burks, 1998). Brazilian pepper seedlings will not tolerate inundation and are quickly killed; however large plants can withstand 6 months of flooding (Francis, n.d.) with several feet of inundation. Brazilian pepper forms dense monocultures and completely shades out, crowds and displaces native vegetation. It also produces allelopathic agents that possibly suppress the growth of other plants. Brazilian pepper is a member of the family Anacardiaceae which includes plants such as poison ivy, poison oak and poison sumac. The leaves, flowers and fruits of Brazilian pepper produce a chemical that can irritate and form a rash on human skin and cause respiratory problems (Langland and Burks, 1998). Approximately 75,310 acres of Brazilian pepper are widely distributed throughout the survey area. It is the most abundant of the species surveyed. In ENP, Brazilian pepper is dominant in certain buttonwood swamps and grass marshes along the inner edge of the southwestern mangrove swamps. Nearly 60% of the Brazilian pepper infestation within the survey area is present from the Ten Thousand Islands area to Cape Sable. This was the most severe infestation that was surveyed. Within the Seminole Indian Reservation, dense infestations of Brazilian pepper are present primarily on improved pastures and along the outer edge of cypress

swamps. Throughout the central Everglades region, Brazilian pepper was present on small tree islands and in many cases dominant in the canopy. Observations of the tree islands from the ground indicated relatively no understory of native vegetation was present beneath the Brazilian pepper canopy. In Big Cypress National Preserve, Brazilian pepper is widely scattered, but it is present in dense infestations in the western Everglades hardwood hammocks. Little to no Brazilian pepper is present on the tree islands of the LNWR.

G.2.1.4 Melaleuca

Melaleuca is an evergreen tree that can grow up to 100 feet tall. It has white flowers that form spikes often referred to as a "bottle brush." The fruit is a round woody capsule in clusters along the stem; each capsule can contain 200-330 tiny seeds. It is native to Australia and was introduced to Florida in 1906 as an ornamental plant and in the 1930's it was scattered over the Everglades in order to create forests (Langeland and Burks, 1998). Melaleuca inhabits natural areas such as pine flatwoods, hardwood bottomlands, cypress forests, freshwater marshes, sawgrass prairies, and mangrove forests. It also infests disturbed sites such as improved pasture, natural rangeland, idle farmland, canal and levee banks and urban areas. It prefers sites that are seasonally wet. Melaleuca also flourishes in areas with standing water and persists in well-drained upland sites (Langeland and Burks, 1998). Melaleuca displaces native plant species, reduces quality of wildlife habitat, alters fire regimes and potentially alters wetland hydrology (Mazotti, Center, Dray and Thayer, 2008). Within the area surveyed, the infestation of melaleuca present is approximately 45,043 acres. The most extensive infestations are present in the East Coast Buffer Lands, Big Cypress Seminole Indian Reservation and in northern sections of LNWR. In Big Cypress National Preserve and eastern ENP, melaleuca is present in small scattered stands in sawgrass and cypress swamps. In the Everglades Wildlife Management Area, melaleuca is considered to be at a maintenance control level.

G.2.1.5 Old World Climbing Fern

Old World climbing fern (*Lygodium microphyllum*), is a plant that has long fronds that can grow up to 90 feet. The fronds grow along the ground, over shrubs or climb by twisting and winding around trees, vines and other structures. The rhizomes and rachis are wiry and they are brown to black in color. The leafy branches that form along the rachis are 2 to 5 inches in length and have many pairs of leaflets. It produces spores that are dispersed by the wind. In south Florida, the plant produces spores throughout the year. Each fertile leaflet of Old World climbing fern can produce up to 28,600 spores. Old World climbing fern is native to Africa, Asia and Australia and the first record of it being found in Florida was in 1958. It was collected from a Delray Beach plant nursery where it was being cultivated (Langeland and Hutchinson, 2005). Old World climbing fern has been documented to occur in hardwood hammocks, mesic flatwoods, forested swamps, wet flatwoods, hydric hammocks, floodplain forests and strand swamps. It can completely overgrow the vegetation in these areas which allows the plant to compete with canopy trees and understory vegetation for light. The growth in the tree canopy provides an avenue for fire spread into the canopy which damages or even kills the trees. Over time, rhizomes accumulate in mats 3 feet or more thick on top of the soil (Langeland et al., 2008) which can prevent new growth of native plants. This plant is a threat to many areas within the project site but in particular to the Everglades tree islands (Ferriter et al., 2005) and disturbed sites. Approximately 17,431 acres of Old World climbing fern infestation are estimated to be present within the area surveyed. Approximately 75% of the Old World climbing fern present occurs within the LNWR. Within this area, dense mats have formed over the tree island

canopies. Approximately 1,988 acres of ENP are infested with Old World climbing fern. It is present in the grass and prairie marsh in the southwestern portions of ENP. This survey was conducted in March 2010, following a frost in this region. Acreage estimates are expected to be low for percent cover and aerial extent due to substantial reductions of Old World Climbing fern from frost damage. This species was not located in WCA 3 while completing the DASM, however ground surveys confirmed Old World Climbing fern was present in the sub-canopy of tree islands.

G.2.1.6 Cattail

Cattails (Typha spp.) are native to Florida and occur in wetlands, lakes, rivers, canals, storm water treatment areas and other disturbed sites. Cattails grow up to 12 feet tall and have strap-like leaf blades. The inflorescence is spike-like with very tiny flowers. This plant is a primary native nuisance species within the project area. Many areas within the project area have been invaded by cattails. This is attributed to water with increased phosphorus being delivered to these areas which began in the late 1950's (Holmes et al., 2002). Areas where water control structures, conveyance features and levees exist provide a suitable habitat for invasion and expansion of cattail. An example of areas that have been impacted include WCA 2, the north east corner WCA 3A, ENP canal and levee banks. One heavily impacted area within the project site is the northern portion of WCA 2 and the Hillsboro Canal. Phosphorus rich water enters WCA 2 through the Hillsboro Canal. Effects of the water extend approximately 3.7 miles south of the canal. The nutrient rich water promoted cattail growth and has allowed cattails to become the dominant plant community within 1.5 miles immediately south of the northern boundary. A mixed community of cattail and sawgrass is present from 1.5 miles to 3.7 miles south of the boundary (Holmes et al., 2002).

G.2.1.7 Localized/Early Detection Rapid Response Species

G.2.1.7.1 Tropical American Watergrass

Tropical American watergrass (*Luziola subintegra*) is a perennial grass that is usually rooted but sometimes grows in floating mats. This plant can also grow in terrestrial sites. It produces a panicle type inflorescence. Tropical American watergrass spreads vegetatively and by seed. It is an aggressive grass that competes with both native and non-native invasive plants. It is native to Mexico, Central America, the Caribbean Basin with its range extending south through South America to Argentina (Krunzer and Bodle, 2008). The first record of occurrence was in Lake Okeechobee in 2007 when two large mats of tropical American watergrass (approximately two and eighty hectares each) were found near Harney Pond Canal in Fisheating Bay at Lake Okeechobee. From the initial population identified, this plant quickly spread and by July 2009 more than 2,000 acres of the plant were treated in the Lake. The plant was also found at the mouth of Fisheating Creek in both emergent and terrestrial forms. Since Fisheating Creek is the only unregulated flow into Lake Okeechobee, it is thought this area was the point of introduction. Since the initial sighting of tropical American watergrass in December 2007, other populations have been found in the Cody's Cove-Eagle Bay area, near Observation Shoal and inside Lake Okeechobee near the S-77 Structure and downstream in the Caloosahatchee River, C-43 canal. The majority of the populations of plants have occurred in areas that receive water flow from Fisheating Bay however one terrestrial population (in two small areas) was identified in the 8.5 Square Mile Area (SMA) adjacent to ENP. Through Early Detection and Rapid Response (EDRR) procedures, this plant was treated and appears to be eradicated in the 8.5 SMA. The source for the introduction of tropical American watergrass into 8.5 SMA is not known at this time, although contaminated equipment is highly suspected.

G.2.1.7.2 Torpedograss

Torpedograss (*Panicum repens*), is a perennial grass that can grow up to 3 feet tall. It has extended rhizomes that can be rooted or floating. It has a panicle-type inflorescence that is 3-9 inches long. It flowers nearly year round. Torpedo grass reproduces primarily through rhizome extension and fragmentation. It is native to Africa and Asia and was introduced into the Gulf Coast of the United States before 1876. Torpedo grass seed was introduced as a forage crop in the south and was planted in almost every southern Florida County by 1950. It is drought tolerant and grows in upland areas but thrives in areas with moist to wet sandy or organic soil. It inhabits scrub, coastal flatwoods, upper tidal marshes, mesic flatwoods, herbaceous wetlands, wet prairies, swales, lake shores, canals and other disturbed sites. Torpedo grass can quickly form a monoculture and displace native vegetation. In 1992, it was present in approximately 70% of the public waters in Florida. The largest population of torpedo grass was present in Lake Okeechobee. Approximately 14,000 acres of torpedo grass displaced native plants in the Lake's marsh (Langeland et al., 2008). Torpedo grass is present in agricultural and water conveyance canals throughout the project area and has potential to spread into areas with the removal of levees and backfilling canals.

G.2.1.7.3 Roundleaf Toothcup (Rotala)

Roundleaf toothcup (*Rotala rotundifolia*) is an aquatic creeping perennial plant (Puri and Haller, 2010). It grows both submersed and emergent (Puri and Haller, 2010). Roundleaf toothcup has a soft stem that is dark pink in color. It branches many times and exhibits a creeping pattern. Aerial leaves are almost round in shape and attach directly to the stem (Jacono and Vandiver, 2007). The submersed leaves are more linear to elongate (Ervin and Madsen, n.d.). Roundleaf toothcup grows approximately 4 to 5 inches in a week. It produces many purple/pink flowers in spikes at the tips of the stems. Roundleaf toothcup is a prolific flower producer; both rooted and floating plants produce flowers. Flowering occurs in spring and early summer and the plant produces fruit that are small capsules (Jacono and Vandiver, 2007). The capsules split along four sides to release the viable seeds. The plant spreads through fragmentation. Since it produces viable seeds it is capable of sexual reproduction but little is known about reproduction in the United States. Roundleaf toothcup is native to southeast Asia, southern India and Japan. In its native range it primarily occurs in mountainous areas. Roundleaf toothcup has been documented to occur in wetlands, low-lying fields, moist pond margins and adjacent to dams and reservoirs (Ervin and Madsen, n.d.). The first plant population in Florida was found in March 1996 in a canal in Coral Springs which is located in Broward County. Other plant populations were found in 2001 in Palm Beach County and 2002 in Lehigh Acres which is in Lee County (Jacono and Vandiver, 2007). The plant is also known to inhabit the L-29 canal which is adjacent to the Tamiami Trail and ENP. When growing as an emergent plant, it forms dense mats that extend across the surface of the water and along shorelines (Ervin and Madsen, n.d.) and shades out submersed species (Puri and Haller, 2010). It is a serious threat for expansion into other areas due to its high growth rate (Ervin and Madsen, n.d.) and ability to reproduce via fragmentation. The growth of this plant has been compared to and exceeds the growth rate of alligatorweed.

G.2.1.7.4 Cogongrass

Cogongrass (*Imperata cylindrica*) is a perennial grass that grows in compact bunches and produces extensive rhizomes. The leaf blades are erect and narrow with a whitish midvein off center and

leaves can be one to four feet in length. The inflorescence is narrow, white and plume-like. Cogongrass flowers in the spring, fall and sometimes year round. It produces seeds that are spread by wind, animals and equipment. Congongrass is native to southeast Asia and was introduced into Florida in the 1930's and 1940's for forage and soil stabilization in Gainesville, Brooksville and Withlacoochee. More than 1,000 acres of cogongrass was established in central and northwest Florida by 1949. Cogongrass inhabits dry to moist sites and has been documented to occur in xeric hammocks, mesic flatwoods, herbaceous marshes, and floodplain forests (Langeland et al., 2008). It has extensively invaded disturbed areas such as fallow pastures (FDEP, n.d.) and is commonly found along transportation and utility corridors (Langeland et al., 2008). Cogongrass forms dense stands which results in almost complete displacement of native plants. Dense stands of cogongrass also create a severe fire hazard, especially when mixed with other volatile fuels (FDEP, n.d.).

G.2.1.8 Other Species of Concern

Other species that are present within, or are likely to invade, the CEPP footprint and cause environmental harm include Napier grass (*Pennisetum purpureum*), water hyacinth (*Eichhornia crassipes*), climbing cassia (*Senna pendula var. glabrata*), lakeshore nutrush (*Scleria lacustris*), castor bean (*Ricinus communis*), crested floating heart (*Nymphoides cristata*), hydrilla (*Hydrilla verticillata*), West Indian marsh grass (*Hymenachne amplexicaulis*), and para grass (*Urochloa mutica*).

G.2.2 Animals

Searches through existing data and resources indicate 89 animal species have been documented to occur within the project area (refer to Table G-4: Invasive Animal Species Documented in the Project Area). Other non-native animal species are probably present; however documented citations could not be located. Information regarding species presence and distribution is largely incomplete for most taxonomic groups of animals. Not all of the 89 non-native animal species identified and documented to occur in the CEPP area will have a significant impact on the ecosystem.

Species that are currently widespread within the project area include the redbay ambrosia beetle (*Xyleborus glabratus) and* associated fungus (*Raffaelea lauricola)* (laurel wilt), Cuban treefrog (*Osteopilus septentrionalis*), Burmese python *(Python molurus bivittatus*), and feral pig (*Sus scrofa*). Localized and/or EDRR species include the Asian swamp eel (*Monopterus albus)*, island apple snail (*Pomacea insularum*), purple swamphen (*Porphyrio porphyrio)*, Argentine black and white tegu *(Tupinambis merianae*), Nile monitor *(Varanus niloticus*), and northern African python (*Python sebae*). Other species of concern include the green iguana (*Iguana iguana*), brown hoplo (*Hoplosternum littorale*), bullseye snakehead (*Channa marulius*), sailfin catfish (*Pterygoplichthys disjunctivus*), and Gambian pouched rat (*Cricetomys gambianus*).

Of the species previously identified there are four key carnivorous reptiles that are currently present within or in close proximity to the project area and have potential to cause significant ecological impacts. These are the Argentine black and white tegu, the Burmese python, the northern African python, and the Nile monitor. These reptiles are among south Florida's most threatening invasive animals. These species are considered top predators and increase additional pressures on native wildlife populations, particularly threatened and endangered species (SFER, 2013).

G.2.2.1 Widely Established Species

G.2.2.1.1 Redbay Ambrosia Beetle (laurel wilt)

Laurel wilt is a lethal disease of redbay (*Persea borbonia*) and other members of the Laurel family (*Lauraceae*). The disease is caused by a fungus (*Raffaelea lauricola*) that is introduced into trees by the wood-boring redbay ambrosia beetle (*Xyleborus glabratus*) (FDACS, 2011b). *Xyleborus glabratus* is the twelfth species of non-native ambrosia beetle known to have become established in the US since 1990. All are suspected to have been introduced in solid wood packing materials, such as crates and pallets (Haack 2003). Most native ambrosia beetles attack stressed, dead or dying woody plants, but *X. glabratus* attacks healthy Florida trees. Once infected, susceptible trees rapidly succumb to the pathogen and die. Besides redbay, it impacts other native and non-native members of the Lauraceae (Hanula et al., 2008) including swamp bay (*P. palustris*), an important species of many Everglades plant communities. Since its arrival in 2002, the red bay ambrosia beetle and laurel wilt have spread quickly throughout the southeastern U.S. In March 2010, the beetle was found in Miami-Dade County. Laurel wilt disease was subsequently confirmed on nearby swamp bay trees in February 2011. Aerial reconnaissance identified symptomatic swamp bay trees scattered throughout the Bird Drive Basin, northward into the Pennsuco Wetland area, and westward into ENP and WCA 3B. In February 2012, laurel wilt was also confirmed in the LNWR. There is currently no feasible method for controlling this pest or associated disease in natural areas. A systemic fungicide (propiconazole) can protect individual trees for up to one year, but widespread utilization in natural areas is impractical (Mayfield et al., 2009). State and federal agencies are monitoring the spread of laurel wilt disease and the red bay ambrosia beetle through the Cooperative Agricultural Pest Survey (CAPS) program. There is little to no research underway to assess the ecological impacts of laurel wilt disease. Interagency coordination is limited to the exchange of reporting information and some coordinated research. The red bay ambrosia beetle is considered a plant pest, so screening for additional introductions is carried out but is inadequate. Critical research areas include: (1) evaluating Persea resistance, (2) Persea seed/genetic conservation efforts, (3) potential chemical or biological control tools, (4) impacts on native plant communities, and (5) impacts on the Palamedes swallowtail butterfly (*Papilio palamedes*) and other host-specific herbivores.

G.2.2.1.2 Asian Swamp Eel

The Asian swamp eel (*Monopterus albus*) is a versatile animal, capable of living in extremely shallow water, traveling over land when necessary, and burrowing into mud to survive periods of drought (Shafland et al., 2010). This species is a generalist predator with a voracious appetite for invertebrates, frogs, and fishes (Hill and Watson 2007; Shafland et al., 2010). Wild populations in Florida originated as escapes or releases associated with aquaculture, the pet trade, or live food markets. Regional biologists are concerned that this species may become widely established, since the diverse wetland habitats of the Greater Everglades may be suitable for the species. Additionally, Asian swamp eels have a broad salinity tolerance giving concern that this species could also establish populations in estuaries (Schofield and Nico, 2009). There are at least four reproducing populations of Asian swamp eels in Florida: North Miami canals, canal networks near Homestead adjacent to the ENP, eastern ENP, and in water bodies near Tampa (Collins et al., 2002; Nico, USGS, personal communication; Jeff Kline, USNPS, personal communication). The impact of Asian swamp eels to Everglades fauna is undocumented and management options are currently limited to monitoring and electrofishing in canals. The species' generalist diet and adaptations to low water

events suggests that native fishes, aquatic invertebrates, and frogs could be threatened. Nico et al. (2011) also report high parasitism rates in wild caught Asian swamp eels in Florida, raising concern that the species could be a vector for macroparasites to native fishes.

G.2.2.1.3 Cuban Treefrog

The Cuban treefrog is the largest species of treefrog in Florida and range from 1-4 inches in length. The Cuban treefrog has expanded pads on the ends of their toes which are exceptionally larger than toepads of Florida's native treefrogs. Cuban treefrogs have large eyes and usually have rough somewhat warty skin. Sometimes Cuban treefrogs have a pattern of large wavy marks or blotches on their back and have stripes or bands on their legs. The color of the treefrogs varies from creamy white to light brown but Cuban treefrogs can be green, beige, yellow, dark brown or combination thereof. It is native to Cuba, the Cayman Islands, and the Bahamas. It was first reported in Florida in the 1920s in the Florida Keys, and was likely transported in cargo or ornamental plant shipments. Cuban treefrogs inhabit natural areas such as pine forests, hardwood hammocks and swamps. They also inhabit disturbed sites such as urban and suburban developments, agricultural areas such as orange groves and plant nurseries (Johnson, 2007). Cuban treefrogs inhabit areas throughout most of the CEPP footprint. These treefrogs are introduced to new areas as stowaways on cars, trucks, boat trailers and through shipment of ornamental plants and trees. Cuban treefrogs consume a variety of invertebrates and native treefrog species (Maskell et al., 2003). Native green and squirrel treefrogs (*Hyla cinerea* and *H. squirella)* are less likely to be found when Cuban treefrogs are present (Waddle et al., 2010), and when Cuban treefrogs are removed from an area, the abundance of native treefrogs increases (Rice et al., 2011). In addition, tadpoles of Cuban treefrogs are fierce competitors and can inhibit the growth and development of two species of native treefrogs (Johnson, 2007). Effects of CEPP projects on the distribution and abundance of Cuban treefrogs should be assessed given the Cuban treefrog's wide distribution and habitat tolerances, mounting evidence of direct impacts to native anuran species, and the lack of regional monitoring and control programs.

G.2.2.1.4 Burmese Python

Burmese pythons are large (up to 5.5 meters) constrictors that are native to Southeast Asia (Dorcas et al., 2012) and are top predators (SFER, 2013). For 20 years prior to being considered established, python sightings occurred intermittently in south Florida. In 2000, the Burmese python was considered established in south Florida and since that time, the population has increased significantly in abundance and geographic range. (Dorcas et al., 2012). The Burmese python is found throughout the southern Everglades, particularly in ENP and adjacent lands including the East Coast Buffer lands and the northern ENP boundary along Tamiami Trail. Sightings have also been documented in the Key Largo region (SFER, 2013). Pythons consume a wide variety of mammals and birds. More than 100 species have been identified as a food source and these include the endangered Key Largo woodrat (*Neotoma floridana smalli*) and the wood stork *(Mycteria americana).* In addition, American alligators (*Alligator mississippiensis*) are infrequently preyed upon by the python. Little is known about the impacts of predation by pythons on native species; however a recent study by Dorcas et al indicates there has been a dramatic decline in mammal populations that coincides with the increase of pythons in ENP (Dorcas et al., 2012). The increase in the population size of pythons has been linked to a regional decline in small and medium mammals (Dorcas et al., 2012), but has not been distinguished from possible effects of changes in habitats and hydrology on mammal populations that also occurred during this time period.

G.2.2.1.5 Feral Hog

Feral hogs (*Sus scrofa*), also known as wild pigs, have existed on the Florida landscape since their introduction four centuries ago. They are reported in all 67 Florida counties within a wide variety of habitats, but prefer oak-cabbage palm hammocks, freshwater marshes and sloughs and pine flatwoods. Although they do not favor marshes with deep water, during the dry season the make extensive use of partially dried out wetlands. Feral hog populations are particularly high in the counties immediately north and west of Lake Okeechobee, and in the Big Cypress and East Coast Regions. Hogs commonly grow 5-6 feet long with weights over 150 pounds. With a keen sense of smell and a powerful snout, they can detect and root up buried food. The diet of feral hogs includes vegetation, earthworms, insects, reptiles, frogs, bird eggs, rodents, small mammals, and carrion (Laycock, 1966; Baber and Coblentz, 1987). This invasive mammal is also known to prey on sea turtles, gopher tortoises, and other at-risk wildlife (Singer, 2005). No animal native to North America creates the kind of disturbance when feeding that hogs do (Baber and Coblentz, 1986). Rooting by feral hogs can convert native grassland and other low vegetation to what looks like plowed fields. Hog rooting may facilitate establishment of invasive plant species because invasive exotics typically favor disturbed areas and colonize more quickly than many native plants (Belden and Pelton, 1975; Duever et al., 1986). Feral hogs are unusually prolific for large mammals. This is because they reach sexual maturity at an early age (6-10 months) (Barrett, 1978), can farrow more than once a year (Springer 1977; Taylor et al., 1998), have large litters (4-8) (Sweeny et al., 2003), and often experience low natural mortality rates (Bieber and Ruf, 2005). Recreational hunting is often a major source of mortality (Barrett and Pine, 1980). In favorable habitat, however, hog populations are typically not greatly reduced by hunting (Bieber and Ruf, 2005). There is no regional, coordinated monitoring program for the ubiquitous feral hog. Monitoring is limited to efforts associated with trapping programs and game management. Numerical monitoring of hogs present challenges because they are wary and adaptable animals that change their activity patterns and feeding areas in response to changing needs and threats from humans (Hughs 1985, Sweeny et al., 2003).

G.2.2.2 Localized/Early Detection Rapid Response Species

G.2.2.2.1 Island Apple Snail

The island apple snail (*Pomacea maculata*) is a freshwater mollusk. This large snail can grow up to 10 centimeters in length. It is native to South America (SFER, 2013). Mating and egg-laying begins in March and can continue through October. It is thought the island apple snail was introduced in Florida in the early 1980's through the tropical pet industry (Fasulo, 2004). This species has been globally introduced through releases associated with aquariums and intentional releases as a food crop. The island apple snail is considered as one of the 100 World's Worst Invasive Alien Species. Potential impacts to Florida flora and fauna include destruction of native aquatic vegetation by consumption and competition with native aquatic fauna. The island apple snail has a voracious appetite for vegetation and in other countries has converted lush ecosystems into barren areas. It is likely the island apple snail will continue to spread and possibly out-compete the native apple snail (*P. paludosa*). The native apple snail is the primary food source for the Everglade snail kite (*Rostrhamus sociabilis*) which is an endangered species (SFER, 2013). The Everglade snail kite is also known to feed on the island apple snail, which has been found in several canals within the CEPP project area. Specifically, it has been documented to occur in the L-29 canal, Old Tamiami Trail canal

which is just inside the northern boundary of the park and in marshes along the Shark Valley tram road which includes ENP along Tamiami Trail. It is also thriving in Lake Okeechobee.

G.2.2.2.2 Purple Swamphen

The purple swamphen (*Porphyrio porphyrio*) is a member of the rail family native to Australia, Europe, Africa, and Asia. It is noticeably larger than its Florida native relatives, the American coot (*Fulica americana*), the common moorhen (*Gallinula chloropus*), and the purple gallinule (*Porphyrio martinica*). The swamphen and the gallinule both have purple plumage and red bills, but the face shield above the bill is red and the legs are pink in the swamphen while the face shield is pale blue, the legs are yellow and the bill has a yellow tip in the gallinule. Introduction of the swamphen was likely due to escapes from the Miami zoo and private aviculturists in Broward County. The purple swamphen feeds on shoots and reeds, invertebrates, small mollusks, fish, snakes, and the eggs and young of waterfowl (Pranty et al., 2000). Nests are typically large mounds of vegetation in wetlands. Known to be highly aggressive and territorial, the purple swamphen could negatively affect native water birds through competition for food and space and through direct predation. Rapid response efforts between 2006 and 2009 did not successfully reduce the abundance or distribution of this species. The management goal for the species has shifted from eradication to suppression (Jenny Ketterlin Eckles, FWC, personal communication). Efforts to remove birds by hunting did not significantly deplete the population. No other control tools are currently developed for this species. In recent years, purple swamphens have been sighted in the WCAs, ENP, Big Cypress National Preserve, Lake Okeechobee, and in all Everglades stormwater treatment areas. The FWC is currently conducting prey and habitat analyses to support a risk assessment, which will guide future management strategies (Jenny Ketterlin Eckles, FWC, personal communication). There are currently no coordinated monitoring efforts for purple swamphens.

G.2.2.2.3 Argentine Black and White Tegu

The Argentine black and white tegu is a large South American lizard that can reach 1.5 meters in length in the wild. Tegus seem to prefer savannas and other grassy open areas in its native range (SFER, 2013). In Florida, tegus seem to prefer disturbed upland areas adjacent to wetlands or permanent bodies of water. These types of habitats are frequently found adjacent to canals and rock pits and occur throughout the South Florida landscape. Tegus are generalist predators with a diet that includes a variety of fruits, vertebrates, invertebrates and eggs. Because the tegu is a predator of eggs, it threatens native ground nesting birds and reptiles which includes threatened and endangered species such as the American crocodile (*Crocodylus acutus*) and Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Endangered snail species such as *Liguus fasciatus* are also potential prey. There are two known established populations in Florida, one in Hillsborough and Polk counties and one in southern Miami-Dade County. The population in Miami-Dade County seems to be increasing and expanding its range both to the west towards ENP and east toward Turkey Point. Both areas are home to endangered wildlife that may be threatened by tegus. Continued monitoring and removal efforts are needed to prevent the expansion into natural areas and control the population. Recently, there has been an increase in sightings near ENP which suggests the population is expanding. Systematic surveys of the species are needed to validate the population is expanding near ENP (SFER, 2011), and to provide early detection of possible range expansion to new areas.

G.2.2.2.4 Nile Monitor

The Nile monitor (*Varanus niloticus*) is a large, carnivorous lizard from sub-Saharan Africa that is capable of reaching 2.4 meters (FWC bioprofile). It is a generalist feeder and an egg specialist in its native range (SFER, 2013) that will feed on a wide variety of invertebrates and vertebrates it acquires by either predation or scavenging (FWC bioprofile). As such, the Nile monitor could impact a variety of native and threatened species in Florida through both competition and predation. The Nile monitor may pose a serious threat to a number of wading birds, marsh birds, gopher tortoises (*Gopherus polyphemus*), burrowing owls (*Athene spp*.), Florida gopher frogs (*Lithobates capito*), sea turtles and other ground nesting species. They may negatively impact populations of American alligators and American crocodiles via egg predation and competition (FWC bioprofile). The Nile monitor has been well established in the Cape Coral area since the 1990s. There is also a small breeding population near Homestead Air Force base in Miami Dade County (SFER, 2011). More recently, a breeding population of Nile monitors has been discovered in Palm Beach County and numerous reports of the species throughout Broward County also suggest a breeding population. Because of their threat to our native wildlife, this species has potential to impact restoration efforts.

G.2.2.2.5 Northern African Python

The northern African python (*Python sebae*) is a large bodied python native to sub-Saharan Africa. It is considered to be one of the largest species of python, with a maximum size of about 20 feet (Alexander and Marais, 2007). Northern African pythons appear to prefer mesic savannah, evergreen forests, mangrove forests, and rocky areas, and typically prefer to be in close proximity to permanent water features (Branch, 1995). Like the Burmese python, the northern African python is an opportunistic predator, consuming a wide variety of prey including small to medium sized mammals, wading birds, lizards, fish, crocodilians, and frogs (Reed and Rodda, 2009). The establishment of northern African pythons in southern Florida was confirmed in 2009. Since then, more than 20 specimens have been collected in the Bird Drive Basin in Miami-Dade County (Jenny Ketterlin Eckles, FWC, personal communication), including multiple large adults, a pregnant female, and two hatchlings. The northern African python is considered a high risk for establishment and expansion throughout southern Florida (Reed and Rodda, 2009). As such, rapid response efforts to delineate and eradicate this population are now of highest priority to local, state, and federal agencies. The SFWMD, Miccosukee Tribe of Indians, and Miami-Dade County, the primary land owners within the Bird Drive Basin, are working closely with the FWC and other agencies to address this emerging threat. The FWC, Miami-Dade County, SFWMD, UF, and other partnering agencies regularly deploy trained python surveyors to the area (SFER, 2013). The northern African python is now classified as a conditional reptile by the State of Florida, and is therefore illegal for personal possession. In 2012, the US Department of the Interior listed this species as an injurious species under the Lacey Act, thereby banning importation and interstate commerce of northern African pythons.

G.2.2.2.6 Other Species of Concern

Other species that are present within, or are likely to invade, the CEPP footprint and cause environmental harm include the green iguana (*Iguana iguana*), brown hoplo (*Hoplosternum thoracatum*), bullseye snakehead (*Channa marulius*), sailfin catfish (*Pterygoplichthys disjunctivus*), and Gambian pouch rat (*Cricetomys gambianus*).

G.3 INTRODUCTION TO MANAGEMENT

G.3.1 Prevention

Prevention is the first-line of defense and the most efficient and cost effective approach to reduce the threat of invasive non-native species. Successful prevention will reduce the rate of introduction and establishment and thereby reduce the impacts of invasive species. One essential element to prevention is identifying the high risk pathways that facilitate introductions and implementing actions to impede those introductions. Other critical elements include using effective management tools to reduce unintentional introductions and using risk assessment for both intentional and accidental introductions of non-native species. Baseline data and monitoring systems are required in order to evaluate the success of preventative measures.

G.3.2 Monitoring

Natural resource managers need spatial data on invasive species populations to develop management strategies for established populations, direct rapid response efforts for new introductions, and evaluate the success of control efforts (Myers et al., 2000; Dewey and Andersen, 2004; Barnett et al., 2007). Several approaches may be taken to document the spatial distribution and population trends of invasive species. Each method has strengths and weaknesses and should be utilized according to specific management objectives. Monitoring is the collection and analysis of population measurements in order to determine changes in population status and progress towards meeting a management objective (Elzinga et al., 1998). This type of monitoring is usually intended to detect relatively small changes in populations over time and often utilize small scale plots and/or transects. Invasive species surveys and inventories may be preferred when the objective is to detect populations and describe their spatial distributions over large landscapes, especially when early detection of new populations is desired (see EDRR discussion below).

Optimally invasive plant mapping methods have high positional accuracy, high species detection accuracy (particularly for low-density infestations), rapid turnaround time, relatively low cost, and the ability to quantify the degree of infestation (USDA, 2012). Ground-based surveys can provide high positional accuracy and species detection, but can be time consuming and logistically unrealistic for large landscapes (Rew et al., 2005). Stratified subsampling approaches to ground surveys can mitigate some of these limitations but probabilistic mapping may be ineffective for early detection needs of land managers (Barnett et al., 2007) and may not provide sufficient fine scale information over large areas.

Developments in remote sensing technology have greatly improved opportunities for rapidly obtaining spatially-precise data on invasive plant populations, particularly for large areas (Lass et al., 2005). However, the ability to detect target species using remote sensing is still limited to conditions where the species has a unique spectral signature or is a dominant canopy species and is often ineffective at detecting target species at low densities (Shafii et al., 2003). This inability to detect target species at low densities is a significant limitation for land managers focused on containment of expanding populations and detection of new invasions. Visual surveys from aircraft have been effectively used to map invasive plant distributions in the Everglades since 2008 (Rodgers and Pernas, in press). While visual aerial surveys may provide cost-effective information on landscape distributions of targeted plants, it has limited value for long-term change detection or fine scale assessments of abundance. This method may also lack sufficient detection precision for small

plant species or species that occupy understories. Use of UAV's may also provide relatively inexpensive invasive plant monitoring data and video documentation provides a permanent record of conditions. However, detection accuracy may be less than that of visual surveys, especially at low densities or new species introductions.

G.3.3 Early Detection and Rapid Response

Once a species becomes widespread, the cost to control it will more than likely require significant and sustained funding. Early detection and rapid response (EDRR) may be a cost-effective strategy to locate, contain, and eradicate invasive species early in the invasion process in order to minimize ecological and economic impacts of non-indigenous species (Rejmanek and Pitcairn, 2002).

The three components of EDRR are *Early Detection*, *Rapid Assessment*, and *Rapid Response*. Early detection is defined as a comprehensive and integrated system of active or passive surveys to locate, identify and report new invasive species as quickly as possible in order to implement procedures when it is feasible and less costly. Rapid Assessment includes the actions necessary to determine the appropriate response. This assessment identifies the current and potential range of the infestation, an analysis of the risks associated with the invasion, and timing and overall strategy for the appropriate actions. Rapid response is defined as a systematic approach to control, contain or eradicate these species while the infestation is still contained in a particular area. Based on the results of the rapid assessment, a rapid response may be implemented to address new introductions or isolated infestations of a previously established species invading a new site (i.e., containment strategy).

Another critical element to rapid response is having the infrastructure in place to quickly implement management actions while new invasions can still be eradicated or contained. Effectively implementing EDRR will require coordination and collaboration among federal, tribal, state, local governments, nongovernment organizations (NGOs) and the private sector (National Invasive Species Council 2008).

G.3.4 Control and Management

Integrated Pest Management (IPM) is an effective approach to manage invasive species. IPM is the coordinated use of the most appropriate strategy to prevent or reduce unacceptable levels of invasive species and their damage by utilizing the most economical means, and with the least possible hazard to people, property and the environment. Physical, mechanical, chemical and biological control methods are utilized in IPM.

Physical control, sometimes referred to as cultural control, is the physical manipulation of an invasive species or their habitat. A number of techniques are used for physical control. These include manual removal, installing barriers and environmental alterations such as water level manipulation, prescribed fire and light attenuation.

Mechanical control refers to the use of machinery designed to cut, shear, shred, uproot, grind, transport and remove invasive species. Equipment used to complete mechanical control may include but is not limited to heavy equipment such as an excavator or front-end loader (with a root rake, grinding heads or other attachments), cutter boats, dredges and mechanical harvesters (Haller, 2009).

Chemical control is the use of a specially formulated pesticide to control an invasive species. The United States Environmental Protection Agency defines a pesticide as "a substance or mixture of substances intended for the prevention, destruction, repulsion, or mitigation of any pest". The term pesticide encompasses a broad range of substances including herbicides, insecticides, fungicides etc. Pesticides are applied through ground and aerial applications.

Biological control, also known as bio-control, is the planned use of one organism to suppress the growth of another. Biological control is primarily the search for and purposeful introduction of species-specific organisms that selectively attack a single target species. Organisms such as insects, animals or pathogens that cause plant diseases are used as biological controls (Cuda, 2009).

Objectives of management can include complete eradication within a given area, population suppression, limiting spread and reducing effects of invasive species. Once an invasive species becomes widely established complete eradication is usually not feasible. The most effective action for managing widely spread invasive species is often preventing the spread and reducing the impacts by implementing control measures. This concept is known as maintenance control. Maintenance control is defined as controlling an invasive species in order to maintain the population at the lowest feasible level.

G.3.5 Risk and Uncertainties Related to Invasive Species

As with most land management activities, there are a number of risks and uncertainties associated with invasive species management. The use of an adaptive management approach will help develop and prioritize invasive species control strategies. As restoration proceeds, invasive species may establish and/or spread as a direct result or independently of restoration activities. In the context of CEPP and the long-term management of the natural resources within the study area, risks include but are not limited to:

- Introduction of new invasive species which are difficult or impossible to control.
- Restoration activities which unintentionally facilitate the spread of invasive species via contaminated earth moving equipment.
- Undetected spread of invasive species into new areas, making containment of populations more costly and less likely to succeed.
- Uncontrolled invasive species which create disturbances or alter ecosystems such that desired restoration outcomes are not achieved.
- Failure to secure necessary funding to control invasive species.
- Undesirable impacts on non-target species and ecosystem functions resulting from invasive species control efforts.
- Not taking action to manage a species due to inaccurate assessments of the species impact on restoration activities.

The major uncertainty is that in most cases we do not have necessary information for detailed, specific pre-project evaluations of the need for management activities to control invasive species. With the exception of a few well-established and well-studied species (e.g., melaleuca), there is an information deficit on the status, potential impact, and effective control techniques for priority species. This is particularly true for non-indigenous animals. Current knowledge on invasion mechanisms suggests that some restoration activities may facilitate the spread of certain priority

species in the Everglades. For example, partial removal of canals and levees could encourage spread of or provide sites for colonization by numerous invasive species, including Brazilian pepper, Old World climbing fern, tegus, Nile monitors, pythons, and Cuban treefrogs. However, there remains considerable uncertainty regarding the degree to which different species will respond, if at all, to restoration activities and how these responses will impact achievement of restoration goals.

Given the high degree of uncertainty, the most effective and lowest cost management option is early detection and rapid removal of invasive species during and post project. Central to this strategy is the implementation of a rigorous monitoring program (discussed below).

Several specific uncertainties have been identified in the initial analysis of the selected plan. They are listed here to provide a starting point for developing monitoring, control and BMP strategies for the construction and operations phases of the restoration.

- Will *Rotala rotundifolia* and other aquatic weeds expand into ENP with expanded conveyance capacity and flow distribution?
- Will increased flow result in increased nutrient loading thereby increasing spread of invasive and/or nuisance plants (e.g., torpedograss, cattail)?
- Will constructed tree islands associated with Miami Canal backfill create desirable habitat for certain invasive plants and animals?
- Will changes in hydrology in WCA 3B promote expansion of Old World climbing fern in tree islands?
- Will non-indigenous fish species spread into new areas as a result of decompartmentalization activities?
- Will there be secured and available funding for management and control of invasive species? Will other priorities outcompete for funds?
- How will the introduction of new invasive species affect ecosystem restoration efforts?
- How will the lack of biological information for new introduced species affect invasive species management?

G.4 EXISTING MANAGEMENT PROGRAMS

G.4.1 South Florida Water Management District

The SFWMD manages invasive exotic aquatic and terrestrial plants in canals and on levees of the C&SF Project, WCAs 2 and 3, stormwater treatment areas (STAs), and interim project lands and on public conservation lands. Most of the vegetation management is outsourced through the Vegetation Management Division and includes herbicide application contractors, mechanical removal contractors, and use of biological controls such as plant specific insects and herbivorous fish. The Melaleuca Control Program is a major focus for the SFWMD, but other priority plant species are controlled within the CEPP study area as funding resources allow.

G.4.2 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) manages floating vegetation on Lake Okeechobee, the Okeechobee Waterway and associated tributaries. The USACE also conducts treatments of priority species on the Herbert Hoover Dike. In addition to the operations and maintenance program on Lake Okeechobee, the USACE conducts treatments of vegetation during the construction phase of

CERP and Modified Water Deliveries to ENP projects in south Florida. Vegetation treated includes FLEPPC Category I and II species, as well as native nuisance species.

G.4.3 Everglades National Park

The ENP Exotic Plant Management Team is actively engaged in treatment of numerous priority invasive plant species, primarily melaleuca, Old World climbing fern, and Australian pine. In recent years, ENP has focused invasive plant control efforts in the northeastern sections of the park and in the extreme southwestern sections where Old World climbing fern aggressively invades marsh communities. Brazilian pepper is also managed as part of the Hole-in-the-Donut restoration program.

G.4.4 U.S. Fish and Wildlife Service

Invasive plant management in the LNWR is carried out by the U.S. Fish and Wildlife Service (USFWS) under a 50-year license agreement with SFWMD. The USFWS invasive plant management strategy addresses control of all invasive, non-indigenous species but the primary focus is on melaleuca, Brazilian pepper, Australian pine, and Old World climbing fern. Brazilian pepper and Australian pine are currently managed at low levels (maintenance control) and melaleuca is nearing low levels in most sections of the refuge. Old World climbing fern remains a significant management challenge given its aggressive invasion in tree islands and limited control options.

G.4.5 U.S. Department of Agriculture / University of Florida

The SFWMD, USACE, NPS, USFWS, FWC, and other agencies provide financial support to the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) and the University of Florida (UF) for the development of invasive plant biological controls. Efforts to identify safe and effective biological controls have led to important advancements in the integrative management of several invaders, including melaleuca, Old World climbing fern, water hyacinth, and alligator weed. The *CERP Melaleuca Eradication and Other Exotic Plants – Implement Biological Controls Project* is dedicated to the implementation of biological control agents once overseas surveys and quarantine testing has developed agents deemed safe for release in Florida. The project includes the construction of a mass rearing annex to the existing USDA-ARS biological control facility in Davie, Florida, in support of implementing the mass rearing, field release, establishment, and field monitoring of approved biological control agents for melaleuca and other invasive nonindigenous species. Construction of the mass rearing facility is underway and is scheduled to be completed by September 2013, when mass rearing and release operations will commence.

G.4.6 Florida Fish and Wildlife Conservation Commission

The FWC's Invasive Plant Management Section is the designated lead entity in Florida responsible for coordinating and funding the statewide control of invasive aquatic and upland plants in public waterways and on public conservation land. In addition to funding the SFWMD melaleuca control program, FWC annually awards funding for individual invasive plant management projects in the Everglades region. Allocation of control funding is determined by an interagency regional working group. FWC land managers also implement control programs for other invasive plant species in wildlife management areas (WMA) within the CEPP footprint, including Holeyland, Rotenberger, Everglades, and Southern Glades WMAs.

G.4.7 Invasive Animals

Efforts to develop control tools and management strategies for several priority species are underway for a few priority animal species. These include the Burmese python and other giant constrictors, the Nile monitor, and the Argentine black and white tegu. Control tools are very limited for free-ranging reptiles, and the application of developed methods is often impracticable in sensitive environments where impacts to non-target species are unacceptable. Available tools for removing large constrictor snakes and lizards currently include trapping, detection dogs, and visual searching. Potential tools include the use of toxicants, introduced predators, and pheromone attractants, but these have not been fully explored to date

Regional invasive biologists have developed a conceptual response framework for established priority invasive animals in south Florida. Objectives within this framework are classified into three main categories—containment (slow the spread), eradicating incipient populations (remove outliers), and suppression (reduce impact in established areas). The resources to implement this strategic framework remain insufficient, but close collaboration between agencies has allowed for some coordinated efforts. Currently, FWC, NPS, UF, and SFWMD are conducting trapping and visual searching for Burmese pythons, northern African pythons, Argentine black and white tegus, spectacled caimans, and Nile monitors.

G.5 EXISTING MONOTORING PROGRAMS

Since 2008, the SFWMD and USNPS, along with other partner agencies, have utilized digital aerial sketch mapping (DASM) for a region-wide mapping program over 728,000 ha in the Everglades. DASM is a method for mapping plant infestations “on-the-fly” using GPS-linked computers and trained biologists. Visual surveys allow an observer to learn to recognize targeted species, sometimes at low densities, under a range of environmental and phenological conditions. Visual aerial surveys also may provide data more rapidly than other methods, which is important when rapid responses to newly established threats are expected. The primary objective of the DASM inventory program is to determine the distributions of four priority invasive plant species on managed conservation lands in the region. These are Australian pine, Brazilian pepper, melaleuca, and Old World climbing fern. A secondary objective of the program is to detect new plant species invasions in remote areas to facilitate rapid response efforts. This data is currently collected on a two year cycle.

There are no system-wide ground based monitoring programs for invasive plants in the Everglades region. Individual agencies may collect spatial information on infestations, but these efforts are not part of a formalized, systematic monitoring network. Interagency working groups (e.g., Everglades Cooperative Invasive Species Management Area (ECISMA)) regularly meet to exchange information on new or potential invasive plants. As these species are detected, ad hoc efforts to conduct rapid assessment (monitoring and risk assessment) and containment are pursued. However, a lack of dedicated funding for rapid response limits the effectiveness of these initiatives.

In 2010, the UF, FWC, and SFWMD began collaboration on the Everglades Invasive Reptile, Amphibian, and Mammal Monitoring Program (EIRAMMP). The purpose of the project is to develop a monitoring program for priority invasive reptiles and amphibians and their impacts to south Florida. Specifically, the program seeks to (1) determine the status and spread of existing

populations and the occurrence of new populations of invasive reptiles and amphibians, (2) provide additional EDRR capability for removal of invasive reptiles and amphibians, and (3) evaluate the status and trends of populations in native reptiles, amphibians, and mammals. The monitoring program involves visual searches for targeted invasive species on fixed routes along levees and roads within Arthur R. Marshall LNWR, WCA's-2&3, Big Cypress National Preserve, and ENP. Visual searches and call surveys, in addition to trapping, are conducted to monitor invasive reptile and amphibian species. Thirteen routes have been established.

G.6 MANAGEMENT STRATEGY AND PLAN

Many of the new features of the water management system, as well as construction and operations and maintenance activities, have the potential to spread and promote establishment of non-native invasive and native nuisance species. Proposed restoration activities may affect ecosystem drivers that directly or indirectly influence the invasiveness of non-native species. These factors may affect invasive species positively or negatively, depending on the unique characteristics of individual species and the environmental conditions for a given biological invasion (Doren et al., 2009). Many of the areas where features are proposed are currently inhabited by non-native invasive and native nuisance species. Construction of the proposed features has the potential to spread the existing non-native invasive and native nuisance species on site as well as introduce new invasive species via contaminated equipment. Disturbed areas resulting from construction are likely to become established with non-native invasive and native nuisance species. New flows created by operations of the proposed features may serve as vectors to spread invasive and native nuisance species into new areas. Monitoring is a critical component of the management strategy. Information on distribution and restoration responses of invasive species should be used to inform decisions on control strategies Invasive species surveillance, monitoring, and control should be carried out within the construction footprints, as well as impacted areas. Species of non-native vegetation to be treated include, but are not limited to, species listed in the current version of the FLEPPC invasive plant lists and the Florida Department of Environmental Protection prohibited plant list. The priorities for managing vegetation include FLEPPC category I and II species, new invasive plant introductions, native nuisance species and plants that impact project operations. Management of animal species will include surveillance, control, and monitoring.

The strategy for managing invasive species will be to utilize an IPM approach. Objectives of management will include complete eradication, population suppression, limiting spread and reducing effects of invasive species. Eradication will be the objective for new established species that are localized. The objective for wide spread invasive species will be to implement control measures to suppress and prevent the spread of identified priority invasive species.

G.6.1 Surveillance – Early Detection and Rapid Response

EDRR should be implemented during every phase, for the life of a project. EDRR is an effective management measure to controlling and containing invasive species that were not previously within the project area. EDRR minimizes the negative impacts the invasive species has on the ecosystem and economy, and reduces future treatment and management costs. It is very difficult to predict when and where an invasive species may appear. As such, estimating a needed budget is near impossible. However, to assist managers, a priority list of species to immediately respond to under EDRR management strategy has been developed (refer to Table G-2: Priority Species / Areas for Early Detection and Rapid Response).

A framework for establishing an EDRR program in the Everglades was recently drafted by an interagency team of invasive species experts and land managers (see ECISMA EDRR Plan at http://www.evergladescisma.org/ECISMA_EDRRPlan_2009-2011.pdf). As discussed above (Section G.3.3 Early Detection and Rapid Response), EDRR includes three strategy elements: 1) early detection, 2) rapid assessment, and 3) rapid response.

1.) Early Detection: This plan proposes implementation of routine surveillance in the project area in order to minimize the time between initial introduction and detection of a new species. Strategic surveillance by trained biologists in proximity to the CEPP project elements should greatly increase the probability of detection of new species. In many cases, existing programs could be expanded to include focused monitoring in the CEPP footprint. For example, the EIRAMMP is well suited for enhanced surveillance for numerous invasive animal species (see Section G.4 EXISTING MANAGEMENT PROGRAMS).

2.) Rapid Assessment: Following the detection of new invasions (or expansion of formerly contained invasions), it is important to gather and process available information to determine the potential risk and control options in the face of high uncertainty. Critical questions must be answered in a relatively short period of time. Example questions include:

- What is the spatial extent and abundance of the non-indigenous species?
- What is the likelihood that the species will impact native species, ecosystem function, operations infrastructure, or human health?
- What are the management options for containment or eradication?

Numerous tools are available to assist natural resource managers with the assessment phase of EDRR, though none of them is likely to be 100% accurate in assessing the risk of a species. This plan proposes utilization of the IFAS Assessment of Non-native plants in Florida's Natural Areas, the Florida Exotic Pest Plant Council's Invasive Species List, the FWC Non-native Animal Bioprofile protocol, and the ECISMA Rapid Response Plan for assessing the risks of non-indigenous species in the CEPP footprint. These assessments should be conducted with CEPP biologists, subject matter experts, and stakeholders.

3.) Rapid Response: This is the "risk management" component of EDRR. Once a species is determined to have a high probability of ecological impact and control options are available, rapid response strategies aimed at containment, and ultimately eradication, can be formulated and implemented. To be effective, rapid response programs must have built in procedural, financial and logistical capacity to respond quickly to newly established threats. Since it is not possible to accurately predict the number and severity of new invasions during the project, this plan proposes contingency funding for rapid response activities in the event new, high-priority species establish in the project area. During the pre-construction phase, protocols for implementing rapid response should be developed.

G.6.2 Control

A combination of biological, physical, mechanical, and chemical control methods will be utilized to manage invasive species.

Biological control agents will be used to decrease the targeted invasive species competitive advantages over native species and to weaken the invading population by increasing leaf mortality, decreasing plant size, reducing flower and seed production, and/or limiting population expansion. Biological control agents will be acquired through the Melaleuca Eradication and Other Exotic Plants – Implement Biological Controls project which is a component of CERP. One element of this CERP component includes the implementation of biological control agents which involves mass rearing, field release, establishment and monitoring of approved biological controls in south Florida and the Everglades. The four main invasive plant species targeted for control through this component include melaleuca, Australian pine, Brazilian pepper and Old World climbing fern.

It is anticipated that physical control methods will be limited. Prescribed burns will be conducted in order to promote native plant growth and should be planned, if possible, to target invasive species when they are most susceptible to fire. Hand pulling of melaleuca and other non-native plant species will occur when it is feasible. Weed/debris barriers will be placed at water control structures when it is required to minimize dispersal of floating vegetation. Physical control measures will be utilized for invasive animal control. Examples of these measures include trapping of feral hogs, controlled harvest/overfishing (nets, fishing tournaments specific to invasive fish species) and compliance with FWC Fishing Regulation release/movement of fish (no return to water/used as bait).

Mechanical control will be implemented to remove non-native plant species when the construction of project features requires such removal. Heavy equipment such as bulldozers, front-end loaders and trackhoes (with or without grinding heads) will be utilized to uproot, grind and/or clear and grub. It is expected this type of control method will be utilized during levee degrades, canal backfilling and during construction of new project features such as water control structures.

Chemical control will be utilized to treat aquatic and terrestrial invasive plants. Methods for treatment will include hack-n-squirt, basal bark, cut-stump, foliar and aerial application. EPA approved herbicides will be utilized to control invasive plants. Chemical control will be utilized to treat invasive plants in canals, along levees, in wetland/natural areas as well as WCA's, FEB's, etc.

G.6.3 Monitoring

Monitoring of invasive species populations will be conducted through DASM, Unmanned Aircraft System (UAS) surveys, electrofishing and EIRAMMP. Invasive species will also be identified through monitoring for the Adaptive Management Plan. This information will be provided to invasive species managers to ensure appropriate management measures are implemented.

G.6.4 Pre-construction Phase

Baseline conditions need to be established prior to the construction phase. Existing monitoring programs should be used as much as possible to establish baseline conditions prior to construction activities beginning. Although there are no system-wide monitoring programs for invasive species in the Everglades region, several individual agencies collect data. Data mining will be the primary resource to obtain baseline data, via collaboration with the individual agencies and the ECISMA. In areas with data gaps, surveys will need to be accomplished by the most cost-effective method (e.g. ground survey, Unmanned Aircraft Systems survey, DASM).

Existing monitoring and management programs should continue to be implemented. The existing programs help maintain invasive and nuisance species at a controlled level.

A significant length of time lapses from the time a project is planned to when it receives congressional authorization and appropriations, and ultimately goes to construction. As property (lands and structures) sit with no activity, vegetation and wildlife changes can occur. Unmanaged areas become inhabited by many species of flora and fauna, native and non-native. Older growth vegetation is more difficult and more costly to treat / remove versus lands that are managed along the way. As these lands become established with invasive species, there is an increased risk of spreading the invasive species to neighboring lands. Therefore, it is beneficial, ecologically and economically, to manage the lands early on. Managing invasive vegetation throughout the interim phase reduces construction costs since mowing is much less costly than clearing/grubbing and treating, and rapid response of new infestations helps reduce spread into environmentally sensitive areas. Site 1 Impoundment is an excellent example. $2.9M is estimated to manage invasive species during construction and until turnover to the local sponsor. The property's prior use included plant nurseries and pasture. Once project lands were acquired by the sponsor, the land sat unused until the Site 1 project was ready to begin construction. By this time, the project lands became highly vegetated, primarily by invasive species. It would have been significantly less expensive to have maintained the lands until the time of construction versus waiting until construction started.

G.6.5 Design and Construction Phases

The best method of controlling invasive and nuisance species is to prevent non-native species from being introduced and established to begin with. Incorporation of invasive species prevention and control into project designs, alternatives analysis, and operational plans has the potential to save significant resources during the long-term. The plans and specifications phase should simply design "with the end in mind." When the end goal is ecosystem restoration, the designers should periodically obtain input from invasive species experts to identify design features and operation strategies that could potentially favor the establishment and spread of invasive species. An example of design influences on invasive species is levee removal without backfill of canals. Without canal backfilling, deep water refuges for non-native fishes and invertebrates (from both seasonal cold temperatures and seasonal drying) are maintained, and barriers to dispersal from canal waters to marsh habitats are removed. Design alternatives should be explored that would allow seasonal cooling of water in the canals. Cooler water temperatures will reduce the refuge capacity for cold temperature sensitive non-native fishes. In some cases, such as the coastal canals, aquatic barrier technologies could be used to mitigate the spread of non-indigenous aquatic species.

Below are examples of cost-saving measures to consider during design and construction.

- Include invasive species management staff from the Corps, SFWMD, and other partner agencies throughout the design and construction phases.
- Work with subject matter experts to identify design features that may create habitat or entry points for invaders. Evaluate design alternatives to mitigate potential design vulnerabilities.
- Design to promote the establishment of native species.
- Use construction methods that minimize ground disturbance whenever possible.
- Contain mobilized nutrients resulting from soil disturbances.

- Require all construction contractors to follow vehicle and equipment decontamination protocols prior to deployment. Coordinate with invasive species specialists for decontamination protocol specifications.
- Evaluate cost/benefit ratios for treating invasive/nuisance species prior to construction activities. In some cases, pre-construction removal of a species may significantly reduce its spread.
- Implement a monitoring and rapid response protocol aimed at detecting and controlling new invasions early.
- Manage and control invasive/nuisance species during the entire construction phase.
- When native planting is specified in the plans, use plant material from regional sources that are weed and pathogen free.

Construction will be the responsibility of either the Corps or the SFWMD. This will be determined at a future time. Regardless of which agency will be responsible, both agencies commit to requiring the construction contractor to implement preventive measures and best management practices that will minimize the potential introduction and spread of invasive and nuisance species due to construction equipment (including personal protective equipment) and activities. This commitment is also included in the Project Implementation Report/Environmental Impact Assessment (Section 5.2.5 Environmental Commitments).

The Corps currently includes the following language in all of their specifications (Specification # 01 57 20 Environmental Protection, "Prevention of Invasive and Nuisance Species Transfer"):

> *The Contractor shall thoroughly clean equipment prior to and following work on the project site to ensure that items/materials including, but not limited to, soil, vegetative debris, eggs, mollusk larvae, seeds, and vegetative propagules are not transported from a previous work location to this project site, nor transported from this project site to another location. Prevention protocols require cleaning all equipment surfaces, including but not limited to, undercarriages, tires, and sheet metal. All equipment, including but not limited to, heavy equipment, vehicles, trailers, ATV's, and chippers must be cleaned. Smaller equipment, including, but not limited to, chainsaws, loppers, shovels, and backpack sprayers, must be cleaned and inspected to ensure they are free of eggs, vegetative debris, vegetative propagules, etc. The Contractor may utilize any method accepted by the Government; common accepted methods include pressure washing and steam cleaning/washing equipment. Prevention protocols should also address clothing and personal protective equipment.*
>
> *Prior to the commencement of work, the Contractor shall complete and provide an invasive and nuisance species transfer prevention plan to the Corps for approval. This plan shall be part of the Environmental Protection Plan as defined in subparagraph "Environmental Protection Plan" of paragraph SUBMITTALS (Part 1.5) above. The invasive and nuisance species transfer prevention plan shall identify specific transfer prevention procedures and designated cleaning sites/locations. Prevention protocols may vary depending upon the nature of the project site. It will be the responsibility of the Contractor to ensure all equipment coming onto and leaving the project site is inspected and not harboring materials that would spread, or potentially spread, invasive and nuisance species onto or off the project site. The Contractor shall provide a report verifying equipment brought on site was cleaned and shall provide a report verifying equipment was cleaned prior to removal from the project site.*

G.6.6 Operational Testing and Monitoring Period

The operational testing and monitoring period is the timeframe from the end of construction until the project is transferred and accepted by the local sponsor. EDRR is very critical and the most cost-effective management measure during this period. Disturbed areas, such as areas impacted from construction activities, are prone to the establishment of invasive and nuisance species. Early detection of invasive and nuisance species and immediate treatment/control measures prevent these species from establishing and becoming long-term problems, ecologically and economically.

G.6.7 OMRR&R Phase

"Prevention of Invasive and Nuisance Species Transfer" language applies not only to the construction phase, but also to the OMRR&R phase. The preventive measure applies to contractors and government employees. Maintenance equipment and rental equipment are often used at multiple locations. As equipment is moved from one location to another, this potential spread vector can easily be reduced / prevented simply by ensuring the equipment is clean prior to arrival on site and prior to leaving the site.

In addition, numerous operational aspects of the restoration can influence mechanisms of invasion. For example, many non-indigenous species become more invasive in environments with elevated nutrient availability. With large pulses of only slightly elevated phosphorus levels, some invasive plant species could establish and spread.

G.6.8 Specific Control by Project Feature – Construction Phase

G.6.8.1 Lake Okeechobee and the Northern Estuaries

Several agencies manage vegetation on Lake Okeechobee and associated water bodies. It is recommended that the agencies continue to aggressively treat priority species to achieve maintenance control in order to minimize spread of those species to other areas.

G.6.8.2 A-2 Flow Equalization Basin

During the construction phase, thorough surveys should be conducted to identify and treat high priority species, which could proliferate after construction phase and impact FEB operations. Depending on design of the FEB, it may or may not be necessary to treat Brazilian pepper or other priority species along the agricultural ditches. If the ditches are filled with existing spoil then Brazilian pepper and other species would be removed by the scraping of material to fill the ditches. If the spoil is not used to fill the ditches then treatment or removal of Brazilian pepper other species should be completed. Management options include aerial herbicide application and mechanical removal via heavy equipment. The levee should be maintained throughout the construction phase to prevent invasion of plant species such as cogongrass. The spreader canal may require maintenance of emergent or other species during the construction phase.

G.6.8.3 Diversion of L-6 Flows and L-5 Improvements

Surveys of the L-5 canal should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. New growth of priority plant species on spoil areas should be treated throughout the construction phase. Woody vegetation should not be piled/disposed of on spoil areas because it could create habitat for certain invasive animal species such as the Burmese python. Electrofishing should be conducted prior to construction to determine the baseline of non-native fish species and to remove high priority species that are present. Periodic electrofishing should be conducted throughout the construction phase to identify and remove high priority non-native invasive fish species.

G.6.8.4 L-4 / L-5 – Spreader Canal and Levee Degradation

Baseline levels of plants should be established prior to construction in WCA 3A. Surveys of the L-5 canal and levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the spreader canal, the marsh immediately downstream of the spreader canal, degraded areas and remnant levee portions should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated.

G.6.8.5 Miami Canal Backfill – S-8 to I-75

Baseline levels of plants in WCA 3A should be established prior to construction. Surveys of Miami Canal and the levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the backfill/degraded areas, remnant levee portions, and constructed tree islands should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent lands within 0.5 mile of the canal and levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper. Diligent monitoring and prompt control of invasive species on constructed tree islands should be a priority during the construction phase as these disturbed soils are very likely to be colonized by invasive plant and animal species.

G.6.8.6 L-28 Levee Degradation / Backfill

Baseline levels of plants in WCA 3A should be established prior to construction. Surveys of the L-28 levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the backfill/degraded areas and remnant levee portions should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent lands within 0.5 mile of the levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.8.7 Increase Capacity of S-333

Monitoring during de-watering operations or other construction activities should occur in order to identify and potentially remove priority fish and other non-native animal species. Priority species present near the water control structure that could be spread by construction equipment and associated construction activities should be treated or removed.

G.6.8.8 L-67A Gated Structures / Spoil Removal

Surveys of the L-67A levee and canal should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the degraded areas, the remnant levee portions, spoil islands and the areas adjacent to the structures should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent lands within 0.5 mile of the levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.8.9 L-67C Levee Degradation

Baseline levels of plants in WCA 3B should be established prior to construction. Surveys of the L-67C levee should be completed prior to construction to identify priority species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Periodic surveys of the degraded areas, remnant levee portions, spoil islands, the spreader canal and the area adjacent to the spreader canal should be conducted throughout the construction phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent lands within 0.5 mile of the levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper. Monitoring throughout the construction phase adjacent to the spreader canal and north and south of the new structures should be conducted in order to identify and treat cattail expansion or other priority species.

G.6.8.10 Build North-South Levee in WCA 3B

During the construction phase, the area impacted by construction should be monitored to identify priority species. In addition, as portions of the levee are completed periodic surveys should be conducted to identify priority species. Such species should be treated throughout the construction phase.

G.6.8.11 L-67 Extension – Levee Degradation / Backfill

Enhance existing monitoring and removal efforts (IRAMP) targeting non-native invasive animals such as the Burmese python prior to beginning levee degradation and canal backfill construction activities. Multiple monitoring and removal efforts should be conducted in order to minimize dispersal of non-native animals due to construction. Surveys of the L-67 Extension levee and canal should be completed prior to construction to identify priority plant species that may be spread by construction activities. Such species should be treated prior to the beginning of construction.

Remaining spoil, levee remnants, degraded and backfill areas should be surveyed during construction and priority species should be treated and/or removed.

G.6.8.12 L-29 Levee Degradation

Surveys of the L-29 levee and canal should be completed prior to construction to identify priority plant species that may be spread (e.g. roundleaf toothcup) by construction activities. Such species should be treated prior to the beginning of construction. Remaining levee remnants, degraded areas and the canal should be surveyed during construction and priority species should be treated and/or removed. Periodic electrofishing should be conducted throughout the construction phase to identify and remove high priority non-native invasive fish species. The area adjacent to the L-29 canal should be monitored for encroachment of cattail and other non-native obligate wetland species. Priority species should be treated. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.8.13 Divide Structure on L-29

A survey of the installation area should be completed prior to construction to identify priority plant species that may be spread (e.g. roundleaf toothcup) by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of submersed and floating species that could impact construction should occur throughout the construction phase.

G.6.8.14 Increase S-356 Capacity to 1,000 cfs

A survey of the area surrounding S-356 should be completed prior to construction to identify priority plant species that may be spread (e.g. roundleaf toothcup) by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of submersed and floating species that could impact construction should occur throughout the construction phase.

G.6.8.15 Remove ~6 Miles of Old Tamiami Trail Roadway from L-67 Extension to Tram Road

Enhance existing monitoring and removal efforts (IRAMP) targeting non-native invasive animals such as the Burmese python prior to beginning roadway degradation construction activities. Multiple monitoring and removal efforts should be completed in order to minimize dispersal of non-native animals due to construction. Surveys of the Old Tamiami Trail should be conducted prior to construction to identify priority plant species that may be spread by construction activities. Such species should be treated prior to the beginning of construction. Remaining spoil, roadway remnants and degraded areas should be surveyed during construction and priority species should be treated and/or removed. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.8.16 G-211 Operational Modifications / Coastal Canals Conveyance

Monitor and treat submersed and floating species that could impact the structure throughout the construction phase.

G.6.8.17 Seepage Barrier

A survey of the installation area should be completed prior to construction to identify priority plant species that may be spread by construction activities. These species should be treated prior to beginning construction activities. Monitoring and treatment of priority plant species within the construction footprint should be conducted throughout the construction phase.

G.6.9 Specific Control by Project Feature – OMRR&R Phase

G.6.9.1 A-2 Flow Equalization Basin

Vegetation within the FEB will be difficult to manage due to high nutrient loading from surface water inflows. Similar conditions are experienced in the storm water treatment areas (STA), and maintenance control of many invasive plant species have proven difficult and not cost-effective. In addition, most of these species have not spread downstream of the STAs into the WCA. Vegetation management within the FEB should focus on maintaining FEB functionality. Vegetation should be controlled to ensure adequate surface water conveyance and minimal impact to infrastructure (e.g., levee instability, floating tussocks). However, any invasive species capable of establishing in the FEB and spreading to natural areas should be a priority for control. Chemical treatments of floating and submersed vegetation should be performed upstream and downstream of water control structures. Occasional mechanical removal of tussocks or uprooted submersed species may be required in order to maintain operations and the function of the FEB. It is recommended to utilize best management practices such as strategic management of vegetation in strips immediately in front of water control structures to prevent floating vegetation and mats from blocking the structures. This has been demonstrated to be an effective management practice in STA's and reduces the cost of operations and maintenance. Levee vegetation should be maintained throughout the OMRR&R phase, with an emphasis on minimizing the spread of invasive plants capable of spreading to natural areas (e.g., cogongrass). The spreader canal will require maintenance of floating, emergent and submersed species in order to maintain the function of the canal.

G.6.9.2 Diversion of L-6 Flows and L-5 Improvements

Monitoring of the L-5 canal should be conducted on a regular basis to identify invasions of priority species. Such species should be treated based on their priority level (i.e. maintenance control or EDRR). Priority species of vegetation on spoil areas should be treated throughout the construction phase. Periodic electrofishing should be conducted to identify and remove high priority non-native invasive fish species.

G.6.9.3 L-4 / L-5 – Spreader Canal and Levee Degradation

This feature will require periodic surveys of the spreader canal, the marsh immediately downstream of the spreader canal, degraded areas and remnant levee portions throughout the OMRR&R phase. The detection of priority invasive plant animal species should trigger prompt control efforts. Regular mowing of any "dead end" levees is recommended to limit the establishment of invasive plant and animal species on the artificially high ground.

G.6.9.4 Miami Canal Backfill – S-8 to I-75

Periodic surveys of the backfill/degraded areas, remnant levee portions and tree islands should be conducted throughout the OMRR&R phase to identify growth of priority species. Priority plant species in these areas should be treated. It is recommended the adjacent lands within 0.5 mile of the canal and levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.9.5 L-28 Levee Degradation / Backfill

Periodic surveys of the backfill/degraded areas and remnant levee portions should be conducted during the OMRR&R phase to identify growth of priority species. Such species should be treated. It is recommended the adjacent lands within 0.5 mile of the levee be surveyed and treated to eliminate close proximity seed sources. This would assist in preventing spread of priority species such as Brazilian pepper.

G.6.9.6 Increase Capacity of S-333

Monitoring during de-watering operations or other construction activities should occur in order to identify and potentially remove priority fish and other non-native animal species. Priority species present near the water control structure that could be spread by construction equipment and associated activities should be treated or removed.

G.6.9.7 L-67A Gated Structures / Spoil Removal

Periodic surveys of the degraded areas, the remnant levee portions, spoil islands and the areas adjacent to the structures should be conducted throughout the OMRR&R phase to identify growth of priority species. Priority plant species in these areas should be treated. The remnant levee portions and spoil islands should be monitored for new colonization of invasive animal species; priority species should be removed.

G.6.9.8 Build North-South Levee in WCA 3B

The area impacted by construction and the levee should be monitored throughout the OMRR&R phase to identify growth of priority species. Priority species should be treated or removed. Cattail growth and expansion is expected along the toe of the levee and should be target for control.

G.6.9.9 L-67 Extension – Levee Degradation / Backfill

Conduct periodic monitoring and removal efforts (IRAMP) targeting non-native invasive animals such as the Burmese python on remnant levee portions during the OMRR&R phase. Monitor remaining spoil, levee remnants, degraded and backfill areas for priority species. Priority species should be treated and/or removed.

G.6.9.10 L-29 Levee Degradation

Remaining levee remnants, degraded areas and the canal should be surveyed during the OMRR&R phase and priority species should be treated and/or removed. Periodic electrofishing should be

conducted to identify and remove high priority non-native invasive fish species. The area adjacent to the L-29 canal should be monitored for encroachment of cattail and other non-native obligate wetland species. Priority species should be treated. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.9.11 Divide Structure on L-29

Monitoring and treatment of submersed and floating species that could impact the structure should occur throughout the OMRR&R phase.

G.6.9.12 Increase S-356 Capacity to 1,000 cfs

Monitoring and treatment of submersed and floating species that could impact the structure should occur throughout the OMRR&R phase.

G.6.9.13 Remove ~6 Miles of Old Tamiami Trail Roadway from L-67 Extension to Tram Road

Perform monitoring and removal efforts (IRAMP) targeting non-native invasive animals such as the Burmese python throughout the OMRR&R phase. Remaining spoil, roadway remnants and degraded areas should be monitored during the OMRR&R phase and priority species should be treated and/or removed. Monitoring for invasive species of apple snail should be conducted and control measures should be implemented if effective control measures are identified.

G.6.9.14 G-211 Operational Modifications / Coastal Canals Conveyance

Monitor and treat submersed and floating species that could impact the structure throughout the OMRR&R phase.

G.6.9.15 Seepage Barrier

Monitoring and treatment of priority plant species within the project footprint should be conducted throughout the OMRR&R phase in order to maintain the integrity of the seepage barrier.

G.7 EDUCATION / OUTREACH

G.7.1 Education / Outreach Opportunities at Recreational Areas

Recreational opportunities will be created by the Central Everglades Planning Project. Recreation areas such as boat ramps, hiking trails, and hunting areas can serve as vectors and pathways for aquatic and terrestrial invasive species. For example, invasive species can be transferred from one area to another by hikers and by boats/trailers. Many recreational users are unaware of their role in the spread of unwanted species. Hence, educating the public on preventing the spread of invasive species can be a cost effective component of the overall management strategy. The recreation access points can be used to display educational information on invasive species identification, prevention/control measures, and awareness of the invasive species programs in the area, and how individuals can contribute to invasive species prevention. Educational kiosks are recommended and should include information on:

- Specific priority invasive species in the area
- Impacts and costs of invasive species on conservation, human health, and recreation
- Preventative measures, such as removing vegetation from boats/trailers before leaving the boat ramp or removing vegetation from shoes and clothing before leaving the area.
- Ways to report invasive species observations
- Programs that citizens can get involved with and learn more about invasive species
- Laws against the release of non-native wildlife

G.8 COSTS

A summary of costs are below in Table G-1: Invasive and Nuisance Species Management Costs. Detailed costs can be found in Tables G-5 and G-6 (Table G-5: Invasive and Nuisance Species Management Costs – Construction Phase and Table G-6: Invasive and Nuisance Species Management Costs – OMRR&R Phase). It was assumed that in the field baselines and potential invasive species treatments and management would need to occur starting about 2 years prior to the actual construction start date. Costs were estimated for the life of the project, assuming a 50-year life. However, due to size, the OMRR&R table only shows years 1 through 3.

TABLE G-1: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS

Invasive and Nuisance Species Management	
2 Years Pre-Construction	$4,946
1 Year Pre-Construction	$719,216
Construction Phase	$4,012,555
Operational Testing & Monitoring Phase	$3,104,255
1 Year OMRR&R Phase	$3,053,740
50-Year OMRR&R Phase (Includes Year 1)	$190,695,832
Total Management Cost	**$198,536,804**
Invasive and Nuisance Species Management Monitoring	
2 Years Pre-Construction	$124,800
1 Year Pre-Construction	$0
Construction Phase	$0
Operational Testing & Monitoring Phase	$356,626
1 Year OMRR&R Phase	$356,626
10-Year OMRR&R Phase (Includes Year 1)	$3,731,096
Total Monitoring Cost	**$4,212,522**

TABLE G-2: PRIORITY SPECIES / AREAS FOR EARLY DETECTION AND RAPID RESPONSE

Species	Natural Area Threat	Structural / Operational Threat
Plants		
Australian pine (*Casuarina spp*.)	X	X
Bishopwood (*Bischofia javanica*)	X	
Brazilian pepper (*Schinus terebinthifolius*)	X	X
Burma reed (*Neyraudia reynaudiana*)	X	
Climbing cassia (*Senna pendula*)	X	X
Cogongrass (*Imperata cylindrica*)	X (uplands only)	X
Floating heart (*Nymphoides cristata*)	X	X
Melaleuca (*Melaleuca quinquenervia*)	X	
Napier grass (*Pennisetum purpureum*)	X (disturbed soils)	X
Old Word climbing fern (*Lygodium microphyllum*)	X	
Para grass (*Urochloa mutica*)	X	X
Roundleaf toothcup (*Rotala rotundifolia*)	X	X
Schefflera (*Schefflera actinophylla*)	X	
Shoebutton Ardisia (*Ardisia elliptica*)	X	
Torpedograss (*Panicum repens*)	X	X
Tropical American watergrass (*Luziola subintegra*)	X	X
West Indian marsh grass (*Hymenachne amplexicaulis*)	X	
Wetland nightshade (*Solanum tampicense*)	X	
Wright's nut-rush (*Scleria lacustris*)	X	
Invertebrates		
Ambrosia beetle (*Xyleborus glabratus*)	X	
Island apple snail (*Pomacea insularum*)	X	
Amphibians		
Cuban treefrog (*Osteopilus septentrionalis*)	X	
Reptiles		
Argentine black and white tegu (*Tupinambis merianae*)	X	
Burmese python (*Python molurus bivittatus*)	X	
Green iguana (*Iguana iguana*)		X
Nile monitor (*Varanus niloticus*)	X	
Fish		
Asian swamp eel (*Monopterus albus*)	X	
Brown hoplo (*Hoplosternum littorale*)	X	
Bullseye snakehead (*Channa marulius*)	X	
Sailfin catfish (*Pterygoplichthys disjunctivus*)	X	X
Mammals		
Feral hog (*Sus scrofa*)	X	X
Gambian pouched rat (*Cricetomys gambianus*)	X	

TABLE G-3: INVASIVE PLANT SPECIES DOCUMENTED IN THE PROJECT AREA

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
rosarypea	*Abrus precatorius* L.	x	x	x	x	I	
Florida Keys Indian mallow	*Abutilon hirtum (Lam.)Sweet*				x		
velvetleaf	*Abutilon theophrasti* Medik		x	x	x		
earleaf acacia	*Acacia auriculiformis* A. Cunningham ex Benth.	x	x	x	x	I	
Bee wattle	*Acacia sphaerocephala Schltdl. & Cham.*				x		
Foxtail copperleaf	*Acalypha alopecuroidea Jacq.*				x		
sisal	*Agave sisalana* Perrine	x	x	x	x	II	
mimosa	*Albizia julibrissin* Durazz.	x	x	x	x	I	
woman's tongue tree	*Albizia lebbeck* (L.) Benth	x	x	x	x	I	
golden trumpet	*Allamanda cathartica* L.	x	x	x	x		
alligatorweed	*Alternanthera philoxeroides* (Mart.) Griseb.	x	x	x	x	II	
sessile joyweed	*Alternanthera sessilis (L.) R. Br. ex DC.*	x	x		x		x
common ragweed	*Ambrosia artemisiifolia* L.	x	x	x	x		
coral vine	*Antigonon leptopus* Hook. & Arn.	x	x	x	x	II	
coral ardisia	*Ardisia crenata* Sims	x	x	x	x	I	
shoebutton ardisia	*Ardisia elliptica* Thunb	x	x	x	x	I	x
Sprenger's asparagus fern	*Asparagus aethiopicus* L.	x	x	x	x	I	
Chinese violet, Ganges primrose	*Asystasia gangetica* (L.) T. Anders	x	x	x	x	II	
mountain ebony	*Bauhinia variegata* L	x	x	x	x	I	
hairy beggarticks	*Bidens pilosa* L.	x	x	x	x		
Javanese bishopwood	*Bischofia javanica* Blume	x	x	x	x	I	
Browne's blechum, green shrimp plant	*Blechum pyramidatum* (Lam.) Urban	x	x	x	x	II	
bottlebrush	*Callistemon viminalis* (Gaertn.)G.Don ex Loudon	x	x	x	x	II	
Alexandrian laurel	*Calophyllum inophyllum* L.				x	I	
Brazilian jackbean	*Canavalia brasiliensis*				x		
river sheoak	*Casuarina cunninghamiana* Miq.	x	x	x	x	II	
Australian-pine	*Casuarina equisetifolia* L.	x	x	x	x	I	
gray sheoak	*Casuarina glauca* Sieb. ex Spreng	x	x	x	x	I	x
Madagascar periwinkle	*Catharanthus roseus* (L.) G. Don	x	x	x	x		
day jessamine	*Cestrum diurnum* L.	x	x	x	x	II	

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
camphortree	*Cinnamomum camphora* (L.) J. Presl	x	x	x	x	I	
turk's turbin	*Clerodendrum indicum* (L.) Kuntze	x	x	x	x		
coco yam, wild taro	*Colocasia esculenta* (L.) Schott	x	x	x	x	I	
Asian nakedwood	*Colubrina asiatica* (L.) Brongn.	x	x	x	x	I	x
Benghal dayflower	*Commelina benghalensis* L.		x				x
smooth crotalaria	*Crotalaria pallida* Aiton	x	x	x	x		
showy rattlebox	*Crotalaria spectabilis* Roth	x	x	x	x		
carrotwood	*Cupaniopsis anacardioides* (A. Rich.) Radlk.	x	x	x	x	I	x
tarweed cuphea	*Cuphea carthagenensis* (Jacq.) J.F. Macbr.	x	x	x	x		
umbrella plant	*Cyperus involucratus* Rottb	x	x	x	x	II	
miniature flatsedge, dwarf papyrus	*Cyperus prolifer* Lam	x	x	x	x	II	
crowfootgrass	*Dactyloctenium aegyptium* (L.) Willd	x	x	x	x	II	
Indian rosewood	*Dalbergia sissoo* Roxb. ex DC.	x	x	x	x	II	
pangolagrass	*Digitaria eriantha* Steud.	x	x	x	x		
violet crabgrass	*Digitaria violascens* Link	x	x	x	x		
winged yam	*Dioscorea alata* L.	x	x	x	x	I	
air-potato	*Dioscorea bulbifera* L.	x	x	x	x	I	x
waterhyacinth	*Eichhornia crassipes* (Mart.) Solms	x	x	x	x	I	
goosegrass	*Eleusine indica* (L.) Gaertn.	x	x	x	x		
Cupid's-shaving-brush	*Emilia fosbergii* D.H. Nicols.	x	x	x	x		
centipede tongavine	*Epipremnum pinnatum* (L.) Engl	x	x	x	x	II	
Surinam cherry	*Eugenia uniflora* L.	x	x	x	x	I	
Chinese banyan	*Ficus microcarpa* L. f.	x	x	x	x	I	
limpograss	*Hemarthria altissima* (Poir.) Stapf & C.E. Hubbard	x	x	x	x	II	
hydrilla	*Hydrilla verticillata* (L. f.) Royle	x	x	x	x	I	
miramar weed, green hygro, Indian swampweed	*Hygrophila polysperma* (Roxb.) T. Anders.	x	x		x	I	
West Indian marsh grass	*Hymenachne amplexicaulis* (Rudge) Nees	x	x	x	x	I	
jaraguagrass	*Hyparrhenia rufa* (Nees) Stapf	x	x		x	II	
Brazilian satintail	*Imperata brasiliensis* Trinius	x	x	x	x		
cogongrass	*Imperata cylindrica* (L.) Beauv.	x	x	x	x	I	x
hairy indigo	*Indigofera hirsuta* L.	x	x	x	x		

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
swamp morning glory	*Ipomoea aquatica* Forssk.	x	x	x	x	I	
ivyleaf morning glory	*Ipomoea hederacea* Jacq.		x		x		
threelobe morning glory	*Ipomoea triloba L.*	x	x	x	x		x
Gold Coast jasmine	*Jasminum dichotomum* Vahl	x	x	x	x	I	
jazmin de trapo	*Jasminum fluminense* Vell.	x	x	x	x	I	
chandelier plant	*Kalanchoe delagoensis* Ecklon & Zeyh.	x	x	x	x		
life plant, cathedral bells	*Kalanchoe pinnata* (Lam.) Pers.				x	II	
Lantana, shrub verbena	*Lantana camara*	x	x	x	x	I	
white leadtree	*Leucaena leucocephala* (Lam.) de Wit	x	x	x	x	II	x
glossy privet	*Ligustrum lucidum* W.T. Aiton		x		x	I	
Chinese privet	*Ligustrum sinense* Lour.	x	x		x	I	
limnophila	*Limnophila sessiliflora* (Vahl) Blume	x	x	x	x	II	
Japanese honeysuckle	*Lonicera japonica* Thunb.		x		x	I	
primrose-willow	*Ludwigia peruviana* (L.) Hara	x	x	x	x	I	
black mangrove	*Lumnitzera racemosa* Willd.				x	I	
watergrass	*Luziola subintegra* Swallen				x	I	
Japanese climbing fern	*Lygodium japonicum* (Thunb. ex Murr.) Sw.	x	x	x	x	I	x
old world climbing fern	*Lygodium microphyllum* (Cav.) R. Br.	x	x	x	x	I	x
catclaw-vine	*Macfadyena unguis-cati* (L.) A.H. Gentry	x	x	x	x	I	
sapodilla	*Manilkara zapota* (L.) van Royen	x	x	x	x	I	
black medic	*Medicago lupulina* L.		x		x		
guineagrass	*Megathyrsus maximus* (Jacq.) R. Webster; *Panicum maximum* Jacq	x	x	x	x	II	
melaleuca	*Melaleuca quinquenervia* (Cav.) Blake	x	x	x	x	I	x
chinaberry	*Melia azedarach* L.	x	x	x	x	II	
molassesgrass	*Melinis minutiflora* Beauv.	x	x	x	x	II	
natalgrass	*Melinis repens* (Willd.) Zizka	x	x	x	x	I	
yellow sweetclover	*Melilotus officinalis* (L.) Lam.	x	x	x	x		
mile-a-minute	*Mikania micrantha*				x	II	
catclaw mimosa	*Mimosa pigra*	x	x	x	x	I	x
balsamapple	*Momordica charantia* L.	x	x	x	x		
sacred bamboo	*Nandina domestica* Thunb.		x			I	

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
Asian swordfern	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	x	x	x	x	I	
narrow swordfern	*Nephrolepis cordifolia* (L.) C. Presl	x	x	x	x	I	
burmareed	*Neyraudia reynaudiana* (Kunth) Keng ex A.S. Hitchc.	x	x	x	x	I	x
white Egyptian lotus	*Nymphaea lotus* L.		x		x		
crested floating heart	*Nymphoides cristata* (Roxb.) O. Ktze.	x	x	x	x	I	
brown-beard rice	*Oryza rufipogon* Griffiths				x		x
sewer vine	*Paederia cruddasiana* Prain				x	I	x
skunk-vine	*Paederia foetida* L.	x	x	x	x	I	x
torpedo grass	*Panicum repens*				x	I	
vaseygrass	*Paspalum urvillei* Steud.	x	x	x	x		
mission grass	*Pennisetum polystachion* (Linnaeus) Schultes		x		x		x
elephant grass, Napier grass	*Pennisetum purpureum* Schumacher	x	x	x	x	I	
common reed	*Phragmites australis australis* (Cav.) Trin. ex Steud.	x	x	x	x		
golden bamboo	*Phyllostachys aurea* Carr. ex A.& C. Rivière	x	x		x		
monarch fern	*Phymatosorus scolopendria* (Burm. f.) Copeland				x	I	
waterlettuce	*Pistia stratiotes*	x	x	x	x	I	
strawberry guava	*Psidium cattleianum* Sabine	x	x	x	x	I	
guava	*Psidium guajava* L.	x	x	x	x	I	
ladder brake	*Pteris vittata* L.	x	x	x	x	II	
kudzu	*Pueraria montana var. lobata* (Willd.) Maesen & S. Almeida	x	x		x	I	x
castorbean	*Ricinus communis* L.	x	x	x	x	II	
downy rose myrtle	*Rhodomyrtus tomentosa* (Ait.) Hassk.	x	x	x	x	I	x
roundleaf toothcup	*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne	x	x	x	x	II	
itchgrass	*Rottboellia cochinchinensis* (Lour.) W.D. Clayton	x	x	x	x		x
Mexican petunia	*Ruellia brittoniana*	x	x	x	x	I	
glenwoodgrass	*Sacciolepis indica* (L.) Chase	x	x	x	x		
water fern	*Salvinia minima* Baker	x	x	x	x	I	
iguanatail	*Sansevieria hyacinthoides* (L.) Druce	x	x	x	x	II	
snake plant	*Sansevieria trifasciata*	x	x		x		

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
beach naupaka	*Scaevola sericea var. taccada* (Gaertn.) Thieret & B. Lipscomb	x	x		x	I	
beach naupaka	*Scaevola taccada* Vahl	x	x	x	x	I	
octopus tree	*Schefflera actinophylla* (Endl.) H.A.T. Harms	x	x	x	x	I	
Brazilian peppertree	*Schinus terebinthifolius* Raddi	x	x	x	x	I	
Brazilian peppertree	*Schinus terebinthifolius var. raddianus* Engl.	x	x	x	x	I	
lakeshore nutrush	*Scleria lacustris* C. Wright	x	x	x	x	I	
climbing cassia, Christmas cassia, Christmas senna	*Senna pendula var. glabrata*	x	x	x	x	I	
red sesbania, purple sesban, rattlebox	*Sesbania punicea* (Cav.) Benth.	x	x	x	x	II	
yellow foxtail	*Setaria pumila* (Poir.) Roemer & J.A. Schultes	x	x	x	x		x
twoleaf nightshade	*Solanum diphyllum* L.	x	x	x	x	II	
Jamaican nightshade	*Solanum jamaicense*	x	x				
wetland nightshade	*Solanum tampicense* Dunal	x	x	x	x	I	x
turkeyberry	*Solanum torvum Sw.*	x	x	x	x	II	x
tropical soda apple	*Solanum viarum* Dunal	x	x	x	x	I	x
annual sowthistle	*Sonchus oleraceus* L.	x	x	x	x		
johnsongrass	*Sorghum halepense* (L.) Pers.	x	x	x	x		
Bay Biscayne creeping-oxeye; wedelia	*Sphagneticola trilobata* (L.C. Rich.) Pruski; *Wedelia trilobata*	x	x	x	x	II	
cayenne porterweed	*Stachytarpheta cayennensis* (Rich.) Vahl	x	x	x	x	II	
American evergreen, arrowhead vine	*Syngonium podophyllum* Schott	x	x	x	x	I	
queen palm	*Syagrus romanzoffiana* (Cham.) Glassman	x	x	x	x	II	
Java plum	*Syzygium cumini* (L.) Skeels	x	x	x	x	I	
sea hibiscus	*Talipariti tiliaceum var. tiliaceum* L.	x	x	x	x	II	
incised halberd fern	*Tectaria incisa*	x	x	x	x	I	
tropical almond	*Terminalia catappa* L.	x	x	x	x	II	
portia tree, seaside mahoe	*Thespesia populnea* (L.) Soland. ex Correa	x	x	x	x	I	
white-flowered spiderwort	*Tradescantia fluminensis* Vell.	x	x	x	x	I	
boatlily	*Tradescantia spathacea* Sw.	x	x	x	x	II	
Chinese tallow	*Triadica sebifera* (L.) Small	x	x		x	I	x

Invasive Plant Species		Region Documented In				FLEPPC Category	Florida Noxious Weed List
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**		
Jamaica feverplant, puncture vine, burr-nut	*Tribulus cistoides* L.	x	x	x	x	II	
coat buttons	*Tridax procumbens* L.	x	x	x	x		x
Caesarweed	*Urena lobata* L.	x	x	x	x	I	
tropical signalgrass	*Urochloa distachya* (L.) T.Q. Nguyen	x	x	x	x		
guinea grass	*Urochloa maxima (= Panicum maximum)*				x	II	
paragrass	*Urochloa mutica* (Forsk.) T.Q. Nguyen	x	x	x	x	I	
simpleleaf chastetree	*Vitex trifolia* L.	x	x	x	x	II	

TABLE G-4: INVASIVE ANIMAL SPECIES DOCUMENTED IN THE PROJECT AREA

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
BIRDS					
Chestnut-fronted Macaw	*Ara severa*				x
Muscovy Duck	*Cairina moschata*	x	x	x	x
Rock Dove	*Columba livia*	x	x	x	x
Scarlet Ibis	*Eudocimus ruber*		x		x
Hill Myna	*Gracula religiosa*	x	x	x	x
Spot-breasted Oriole	*Icterus pectoralis*	x	x	x	x
Budgerigar	*Melopsittacus undulatus*	x	x		x
Monk Parakeet	*Myiopsitta monachus*	x	x	x	x
House Sparrow	*Passer domesticus*	x	x	x	x
Purple Swamphen	*Porphyrio porphyrio*	x	x	x	x
Red-whiskered Bulbul	*Pycnonotus jocosus*				x
Eurasian Collared-Dove	*Streptopelia decaocto*	x	x	x	x
European Starling	*Sturnus vulgaris*	x	x	x	x
White-winged Dove	*Zenaida asiatica*	x	x	x	x
REPTILES & AMPHIBIANS					
African Redhead Agama	*Agama agama*	x	x	x	x
Giant Ameiva	*Ameiva ameiva*				x
Hispaniolan Green Anole	*Anolis chlorocyanus*				x
Puerto Rican Crested Anole	*Anolis cristatellus cristatellus*				x
Largehead Anole	*Anolis cybotes*	x	x		
Bark Anole	*Anolis distichus*	x	x	x	x
Knight Anole	*Anolis equestris equestris*	x	x	x	x
Jamaican Giant Anole	*Anolis garmani*	x	x	x	x
Cuban Green Anole	*Anolis porcatus*				x
Brown Anole	*Anolis sagrei*	x	x		
Brown Basilisk	*Basiliscus vittatus*	x	x	x	x
Common Boa	*Boa constrictor*	x	x	x	x
Spectacled Caiman	*Caiman crocodilus*				x
Oriental Garden Lizard	*Calotes versicolor*	x	x		
Veiled Chameleon	*Chamaeleo calyptratus*	x	x	x	x
Rainbow Lizard	*Cnemidophorus lemniscatus*				x
Giant Whiptail	*Cnemidophorus motaguae*				x
Mexican Spinytail Iguana	*Ctenosaura pectinata*				x
Black Spinytail Iguana	*Ctenosaura similis*	x	x		x
Greenhouse Frog	*Eleutherodactylus planirostris*		x		
Green anaconda	*Eunectes murinus*				x
Yellow anaconda	*Eunectes notaeus*				x
Tokay Gecko	*Gekko gecko*	x	x	x	x
Common House Gecko	*Hemidactylus frenatus*				x
Indo-Pacific Gecko	*Hemidactylus garnotii*		x		x
Tropical House Gecko	*Hemidactylus mabouia*	x	x	x	x
Mediterranean Gecko	*Hemidactylus turcicus*	x	x	x	x

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
REPTILES & AMPHIBIANS (continued)					
Green Iguana	*Iguana iguana*	x	x	x	x
Northern Curlytail Lizard	*Leiocephalus carinatus armouri*	x	x	x	x
Red-sided Curlytail Lizard	*Leiocephalus schreibersii schreibersii*		x		x
Butterfly Lizard	*Leiolepis belliana belliana*				x
Many-lined Grass Skink	*Mabuya multifasciata*				x
Cuban Treefrog	*Osteopilus septentrionalis*	x	x	x	x
Giant Day Gecko	*Phelsuma madagascariensis grandis*				x
Texas Horned Lizard	*Phrynosoma cornutum*	x	x	x	x
Reticulated python	*Python reticulatus*				x
Northern African python	*Python sebae (Gmelin, 1788)*				x
Burmese Python	*Python molurus bivittatus*	x	x	x	x
Brahminy Blind Snake	*Ramphotyphlops braminus*	x	x		x
Giant Toad	*Rhinella marina*	x	x	x	x
White-spotted Wall Gecko	*Tarentola annularis*		x		x
Red-eared Slider	*Trachemys scripta elegans*				x
Black and white tegu	*Tupinambis merianae Linnaeus, 1758*				x
Nile Monitor	*Varanus niloticus*	x	x	x	x
FISH					
Oscar	*Astronotus ocellatus*				x
Pike killifish	*Belonesox belizanus*	x	x	x	x
Bullseye snakehead	*Channa marulius*				x
Clown knifefish	*Chitala ornata*	x	x	x	x
Butterfly peacock	*Cichla ocellaris*				x
Black acara	*Cichlasoma bimaculatum*				x
Midas cichlid	*Cichlasoma citrinellum*				x
Jaguar guapote	*Cichlasoma managuense*	x	x	x	x
Yellowbelly cichlid	*Cichlasoma salvini*				x
Mayan cichlid	*Cichlasoma urophthalmus*				x
Walking catfish	*Clarias batrachus*				x
African jewelfish	*Hemichromis letourneuxi*	x	x	x	x
Brown hoplo	*Hoplosternum littorale*				x
Suckermouth catfish	*Hypostomus sp.*				x
Asian swamp eel	*Monopterus albus*				x
Blue tilapia	*Oreochromis aureus*				x
Orinoco sailfin catfish	*Pterygoplichthys multiradiatus*				x
Spotted tilapia	*Tilapia mariae*				x
MAMMALS					
Coyote	*Canis latrans*	x	x	x	x
Vervet Monkey	*Chlorocebus aethiops*	x	x	x	x
Ninebanded armadillo	*Dasypus novemcinctus*				x
Black rat	*Rattus rattus*				x
Squirrel Monkey	*Saimiri sciureus*		x		x
Mexican Red-bellied Squirrel	*Sciurus aureogaster*				x
Wild hog, feral pig	*Sus scrofa*	x	x	x	x

Invasive Animal Species		Region Documented In			
Common Name	***Scientific Name***	**LO**	**NE**	**EAA**	**GE**
OTHER					
Spiketop applesnail	*Pomacea diffusa Blume, 1957*	x	x	x	x
Titan apple snail	*Pomacea haustrum (Reeve, 1858)*	x	x	x	x
Island applesnail	*Pomacea maculata*	x	x	x	x
Asian tiger mosquito	*Aedes albopictus (Skuse)*	x	x	x	x
Mexican bromeliad weevil	*Metamasius callizona*	x	x	x	x
Redbay ambrosia beetle	*Xyleborus glabratus Eichhoff, 1877*				x
Fungus (causes laurel wilt)	*Raffaelea lauricola*				x

TABLE G-5: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS – CONSTRUCTION PHASE

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
A-2 Flow Equalization Basin (14,000) *Construction Period - 2.5 years*	EDRR Surveillance - Plants		$20,880	$92,800	$74,240
	Plant Control/Treatment		$241,500	$282,555	$209,300
	EDRR Surveillance and Removal Animals			$58,325	$58,325
	Coordination/Inspections/ Contract Implementation		$65,595	$93,839	$70,885
L-5 (Improvements / Modifications) *Construction Period - 1.5 years*	EDRR Surveillance - Plants		$1,856	$11,136	$14,848
	Plant Control/Treatment		$523	$3,140	$2,093
	EDRR Surveillance and Removal Animals				$4,800
	Electrofishing		$24,000	$36,000	$48,000
	Coordination/Inspections/ Contract Implementation		$6,595	$12,569	$17,435
L-6 *Construction Period - 1 year*	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
	Plant Control/Treatment		$1,196	$2,392	$4,784
	Coordination/Inspections/ Contract Implementation		$763	$2,454	$4,908
L-4 Levee Degrade (2.9 miles) *Construction Period - 2 years*	EDRR Surveillance - Plants		$928	$7,424	$7,424
	Plant Control/Treatment		$1,610	$1,387	$19,320
	EDRR Surveillance and Removal Animals				$1,160
	Electrofishing		$9,600	$19,200	$19,200
	Coordination/Inspections/ Contract Implementation		$3,035	$7,003	$11,776
Divide Structure on L-4 *(Assuming Construction Period 1 year)*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$288	$575	$1,150
	Coordination/Inspections/ Contract Implementation		$304	$608	$1,216
WCA-3A	EDRR Surveillance - Plants		$25,520	$111,360	$55,680
	Plant Control/Treatment			$598,000	$299,000
	Electrofishing		$32,000	$64,000	$64,000
	Coordination/Inspections/ Contract Implementation		$14,380	$193,340	$104,670
Miami Canal Backfill	EDRR Surveillance - Plants		$2,784	$44,544	$22,272

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
(13.5 miles - Table 5-1 PIR) *Construction Period - 4 years*					
	Plant Control/Treatment		$7,590	$22,770	$11,385
	EDRR Surveillance and Removal Animals				$28,000
	EDRR Surveillance and Removal Animals				$2,700
	Electrofishing		$21,600		
	Coordination/Inspections/ Contract Implementation		$7,994	$16,829	$16,089
Increase Capacity of S-333 *Construction Period - 4 years*	EDRR Surveillance - Plants		$928	$7,424	$3,712
	Plant Control/Treatment		$575	$4,600	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$3,006	$1,503
L-67A -2 gated structures *Construction Period - 1/2 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$752	$1,503
L-67-A - Spoil Removal *Construction Period - 1/2 year*	EDRR Surveillance - Plants		$928	$1,856	$7,424
	Plant Control/Treatment		$920	$3,128	$25,024
	Coordination/Inspections/ Contract Implementation		$462	$1,246	$8,112
L-67C Levee Degrade (6,000 feet) *Construction Period - 2 years*	EDRR Surveillance - Plants		$928	$3,712	$3,712
	Plant Control/Treatment		$1,012	$10,157	$10,157
	Coordination/Inspections/ Contract Implementation		$485	$3,467	$3,467
Gated Structure N/Blue Shanty Levee *Construction Period - 1/2 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$752	$1,503
L-67C Levee Degrade 8 miles *Construction Period -2 years*	EDRR Surveillance - Plants		$928	$3,712	$3,712
	Plant Control/Treatment		$5,382	$53,544	$53,544
	Coordination/Inspections/ Contract Implementation		$1,578	$14,314	$14,314

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
Construction of N/S Levee	EDRR Surveillance - Plants			$55,680	$27,840
	Plant Control/Treatment			$862,077	$646,558
	Coordination/Inspections/ Contract Implementation			$275,327	$202,319
L-67 Extension - Levee Degrade / Backfill *Construction Period -1 year*	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
	Plant Control/Treatment		$3,105	$15,525	$31,050
	EDRR Surveillance and Removal Animals	$1,100	$1,100	$550	$2,200
	Coordination/Inspections/ Contract Implementation	$275	$1,051	$4,019	$8,313
L-29 Levee Degrade 4.3 miles *Construction Period - 1 year*	EDRR Surveillance - Plants		$1,856	$7,424	$14,848
	Plant Control/Treatment		$3,864	$14,490	$28,980
	EDRR Surveillance and Removal Animals	$860	$860	$430	$1,720
	Electrofishing		$32,000	$64,000	$64,000
	Coordination/Inspections/ Contract Implementation	$387	$14,787	$28,994	$29,574
Divide Structure on L-29 *Construction Period -1 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$752	$1,503
Increase Capacity S-356 *Construction Period -3 years and 3 months*	EDRR Surveillance - Plants		$928	$6,496	$3,712
	Plant Control/Treatment		$575	$4,025	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$2,630	$1,503
Old Tamiami Trail *Construction Period -3 years*	EDRR Surveillance - Plants		$4,640	$27,840	$18,560
	Plant Control/Treatment		$5,336	$23,920	$47,840
	EDRR Surveillance and Removal Animals	$1,200	$1,200	$1,800	$2,400
	Coordination/Inspections/ Contract Implementation	$300	$2,794	$13,390	$17,200
G-211 Modifications *Construction Period -1 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$752	$1,503

Invasive and Nuisance Species Management - Construction Phase					
Feature / Area	**Management Activity**	**Pre-Construction 2 Years**	**Pre-Construction 1 Year**	**Construction**	**Operational Testing & Monitoring Phase**
Seepage Barrier *Construction Period -1 year*	EDRR Surveillance - Plants		$928	$1,856	$3,712
	Plant Control/Treatment		$575	$1,150	$2,300
	Coordination/Inspections/ Contract Implementation		$376	$752	$1,503
Everglades National Park	EDRR Surveillance - Plants		$4,640	$55,680	$18,560
	Plant Control/Treatment			$30,139	$24,111
	Coordination/Inspections/ Contract Implementation		$1,160	$21,455	$10,668
		$4,122	**$599,346**	**$3,343,796**	**$2,586,880**
Other Cost		$824	$119,869	$668,759	$517,375
	Management Activities Oversight Revise/Update INSMP Development of EDRR Framework Budget, Contract, Administrative Support Assessment of Species				
	Total	**$4,946**	**$719,216**	**$4,012,555**	**$3,104,255**
	Total Cost Estimate	**$7,840,973**			

TABLE G-6: INVASIVE AND NUISANCE SPECIES MANAGEMENT COSTS – OMRR&R PHASE

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
A-2 FEB	EDRR Surveillance - Plants	$18,560	$1,196,437
	Plant Control/Treatment - Floating/Emergent	$125,580	$8,095,286
	Plant Control/Treatment - Submersed	$14,375	$926,658
	EDRR Surveillance/Removal Animals	$58,325	$3,759,815
	Coordination/Inspections/Contract Implementation	$43,368	$2,795,639
L-5	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment (14a)	$8,372	$539,686
	EDRR Surveillance/Removal Animals	$1,200	$77,356
	Electrofishing	$24,000.0	$1,547,116
	Coordination/Inspections/Contract Implementation	$8,199	$528,547
L-6	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$9,568	$616,784
	Coordination/Inspections/Contract Implementation	$3,398	$219,072
L-4 Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment (28a)	$9,660	$622,714
	EDRR Surveillance/Removal Animals	$290	$18,694
	Electrofishing Coordination/Inspections/Contract Implementation	$9,600 $4,652	$618,847 $299,909
Divide Structure on L-4	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$575	$37,066
	Coordination/Inspections/Contract Implementation	$857	$55,271
WCA-3A	EDRR Surveillance - Plants	$55,680	$3,589,310
	Plant Control/Treatment	$179,400	$11,564,695
	Electrofishing	$32,000	$2,062,822
	Coordination/Inspections/Contract Implementation	$53,416	$3,443,365
Miami Canal Backfill	EDRR Surveillance - Plants	$11,136	$717,862
	Plant Control/Treatment (165a)	$28,463	$1,834,783
	EDRR Surveillance/Removal Animals	$14,000	$902,485
	EDRR Surveillance/Removal Animals	$1,350	$87,025
	Electrofishing	$21,600	$1,392,405
	Coordination/Inspections/Contract Implementation	$15,310	$986,912

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
Increase S-333 Capacity	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67A 2 gated structures	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67A - Spoil Removal	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$12,512	$806,563
	Coordination/Inspections/Contract Implementation	$3,245	$209,170
L-67C Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$10,157	$654,740
	Coordination/Inspections/Contract Implementation	$2,774	$178,805
Gated Structure N/Blue Shanty Levee	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$2,300	$148,265
	Coordination/Inspections/Contract Implementation	$1,202	$77,511
L-67C Levee Degrade	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment (97a)	$2,677	$172,581
	Coordination/Inspections/Contract Implementation	$1,278	$82,374
N/S Levee WCA-3B	EDRR Surveillance - Plants	$27,840	$1,794,655
	Plant Control/Treatment	$862,077	$55,572,214
	Coordination/Inspections/Contract Implementation	$177,983	$11,473,374
L-67 Extension Levee Degrade / Backfill	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$31,050	$2,001,582
	EDRR Surveillance/Removal Animals	$550	$35,455
	Coordination/Inspections/Contract Implementation	$7,805	$503,122
L-29 Levee	EDRR Surveillance - Plants	$7,424	$478,575
	Plant Control/Treatment	$19,320	$1,245,429
	Plant Control/Treatment - Submersed	$8,625	$555,995
	EDRR Surveillance/Removal Animals	$430	$27,719
	Electrofishing	$32,000	$2,062,822

Invasive and Nuisance Species Management - OMRR&R Phase			
Feature / Area	**Management Activity**	**Year 1 OMRR&R**	**50-Year OMRR&R**
	Coordination/Inspections/Contract Implementation	$13,560	$874,108
L-29 Divide Structure	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract implementation	$972	$62,684
Increase Capacity S-356	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684
Old Tamiami Trail	EDRR Surveillance - Plants	$9,280	$598,218
	Plant Control/Treatment	$47,840	$3,083,919
	EDRR Surveillance/Removal Animals	$1,200	$77,356
	Coordination/Inspections/Contract Implementation	$11,664	$751,899
G-211 Modifications	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684
Seepage Barrier	EDRR Surveillance - Plants	$3,712	$239,287
	Plant Control/Treatment	$1,150	$74,133
	Coordination/Inspections/Contract Implementation	$972	$62,684
Everglades National Park	EDRR Surveillance - Plants	$18,560	$1,196,436
	Plant Control/Treatment	$24,111	$1,554,295
	Coordination/Inspections/Contract Implementation	$8,534	$550,146
		$2,181,243	$140,609,877
Other Costs			
	Oversight of Management Activities Revise/Update INSMP Budget, Contract, Administrative support Assessment of Species Coordination with other agencies/EDRR response		
	Total Other Cost	$872,497	$49,213,457
	Total Cost Estimate	**$3,053,740**	**$190,695,832**

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